BARRIERS TO GOVERNMENTAL SECTOR E-BIDDING WITHIN SAUDI ARABIA'S CONSTRUCTION INDUSTRY

BY

AHMED MOHAMMED ZAKI SAYED

A Thesis Presented to the
DEANSHIP OF GRADUATE STUDIES

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DHAHRAN, SAUDI ARABIA

In Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

In

CONSTRUCTION ENGINEERING AND MANAGEMENT

May 2016

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DHAHRAN 31261, SAUDI ARABIA

DEANSHIP OF GRADUATES STUDIES

This thesis, written by

AHMED MOHAMMED ZAKI SAYED

Under the direction of his Thesis Advisor, and approved by all Thesis Committee, has been presented to and accepted by the Dean of Graduate Studies, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN CONSTRUCTION ENGINEERING & MANAGEMENT.**

THESIS COMMITTEE:

Dr. Khalaf Al-Ofi
CEM Department Chairman

Dr. Sadi A. Assaf
Advisor

Dr. Salam A. Zummo
Dean of Graduates Studies

Dr. Adel Aldosary
Member

Date 2/11/16

30/10/16
Dr. Ali Shash
Member

DEDICATION

To my beloved Mother, for her prayers to me.

To my Father, Mohammed Zaki Maeen, the first to teach me.

To my Brothers, Amr and Hazem, for care and support all the time.

And to this Country, Kingdom of Saudi Arabia, where I was born and lived the best days of my life.

ACKNOWLEDGEMENT

In the name of Allah, Most Gracious, Most Merciful

I wish to express my deep appreciation to my advisor, Professor Sadi A. Assaf, for all the support and guidance. I also appreciate his positive comments and advices throughout my research.

Thanks are due also to other members of the thesis committee Professor Adel Aldosary and Professor Ali Shash.

Acknowledgement is due to King Fahd University of Petroleum & Minerals and in particular to the Department of Construction Engineering & Management for supporting this research.

My thanks and gratitude is due also to my family for their encouragement without which this work would not have been possible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

THESIS ABSTRACT

Name of Student: AHMED MOHAMMED ZAKI SAYED

Title of the study: BARRIERS TO GOVERNMENTAL SECTOR E-BIDDING WITHIN SAUDI ARABIA'S CONSTRUCTION INDUSTRY

Degree: Master of Science

Field of Study: Construction Engineering & Management

Date: May, 2016

E-bidding is a technology that has the potential to grant the stakeholders of the construction industry in Saudi Arabia the power to manage the whole bidding process electronically and on the web. By using this system, many benefits could be gained.

Despite the benefits, there are many barriers to implement this technology in the Saudi Arabian governmental procurement system.

This research addresses the drivers and barriers to the e-bidding system in Saudi Arabia. In addition, it examines the level of readiness of the governmental sector e-bidding system within the context of the Saudi Arabian construction industry. Thirteen driver factors and twenty-seven barrier factors were identified from previous studies. Ultimately, the aim of the research was to identify the drivers, challenges and willingness of the stakeholders (i.e., governmental authorities and contractors) to adopt the e-bidding system in Saudi Arabia. The method employed to achieve these objectives was a survey. The survey questionnaire incorporated a scale ranging from 1 to 5, where 1 is the least effective and 5 is the most effective.

A total of 32 respondents participated in this research. Of these, 20 were contractors and 12 were governmental authorities. The analysis of driver factors revealed that 'enhancing documents management and archiving cost' is the most important factor from the perspective of both the contractors and governmental authorities. The analysis of barrier factors shows that 'Security in the process - data transmission to the wrong person – confidentiality of information' is the most important barrier from the perspective of the contractors. The most important barrier from the perspective of the governmental authorities is 'organisational magnitude of changing management.'

It was found that the most ready element in the contractor organisations was 'financial sources to fund the e-bidding system' while for the governmental authorities it was 'organisation higher management.'

The contractors viewed the internet service providers as the most ready element in the construction industry. The governmental authorities, on the other hand, saw the construction contractors as the most ready element in the construction industry.

Both the parties displayed agreements with respect to the importance and ranking of the factors in all the four identified aspects.

خلاصة الرسالة

اسم الطالب بالكامل : احمد محمد زكى سيد

عنوان الرسالة : العقبات التي تعترض نظام المنافسات الأليكترونية بالقطاع الحكومي ضمن صناعة الانشائات بالمملكة العربية السعودية

التخصص : هندسة البناء و الإدارة

تاريخ الشهادة : رجب ١٤٣٧ هـ

إن إستخدام المنافسات الاليكترونية سيمكن أطراف صناعة الانشائات بالسعودية من ادارة عملية العطاء اليكترونيا و من خلال شبكة الإنترنت. من خلال إستخدام هذا النظام يمكن التحصل على العديد من الفوائد.

بالرغم من الفوائد العديدة, إلا هناك العديد من العوائق التي تقف أمام تطبيق هذه التكنولوجيا في نظام المشتريات السعودي.

يتناول هذا البحث الدوافع و العوائق و مستوى الاستعداد لنظام المنافسات الأليكترونية بالقطاع الحكومي ضمن صناعة الانشائات بالمملكة العربية السعودية. تم تحديد ١٣ عامل دافع و ٢٧ عامل معوق من خلال البحوث السابقة و كذلك الاستقصاء.

الهدف من هذا البحث هو تعريف العوامل الدافعة و التحديات و مستوى الاستعداد لتبني نظام المنافسات الحكومية بالمملكة العربية السعودية بواسطة أطراف صناعة الانشاء (الجهات الحكومية و المقاولين). النهج المستخدم لتحقيق هذه الاهداف كان عن طريق استخدام " الاستبيان". في هذا الاستبيان تم ادراج مقياس من ١ الى ٥ , حيث تمثل ١ الاقل أهميه و تمثل ٥ الأكثر أهمية.

شارك في هذا البحث ٣٢ مشارك منهم ٢٠ من المقاولين و ١٢ من الجهات الحكومية. بيَن تحليل العوامل الدافعة أن تحسين إدارة الوثائق والأرشفة هو أهم عامل دافع للمقاولين و كذلك الجهات الحكومية. كذلك بيَن تحليل العوامل العائقة أن الأمان في العملية- نقل البيانات للشخص الخطأ- سرية البيانات هو أهم عامل عائق للمقاولين و أن عزم جهة العمل على تغيير نظام الادارة هو أهم عائق للجهات الحكومية.

أكثر عنصر استعدادا في جهة العمل لتبنى إستخدام العطاءات الإلكترونية بالنسبة للمقاولين هو المصادر المالية لتمويل النظام. أما بالنسبة للجهات الحكومية فهو الإدارة العليا لجهة العمل. أكثر عنصر استعدادا في صناعة الانشائات من وجهة نظر المقاولين هو شركات خدمات الانترنت. أما من وجهة نظر الجهات الحكومية هو مقاولين الانشاء.

كلا الطرفين عرضا اتفاقا فيما يتعلق بأهمية العوامل في جميع الجوانب الاربعة التي تم تحديدها.

CHAPTER 1

Introduction

1.1 *Introduction*

As the use of the internet becomes increasingly ubiquitous and as the Saudi government introduces its new strategy of converting into a fully e-government, e-bidding can be introduced as an effective replacement of the traditional paper-based processes. E-bidding enables organizations to manage its entire bidding process electronically and on the web (Anumba C.J. and Ruikar K.2002). Many benefits could be gained from using e-bidding system especially when considering that one of the most important phases in the construction industry is the bidding process (Arslan et al.2008). During the bidding process, tendering documentation and conducting tender obtaining processes requires tremendous amount of man force. Similarly, obtaining and submitting tenders are also costly for suppliers (Liao, T.S, Wang and Tserng, 2002).

Despite the benefits that could be reaped from employing e-bidding system, many barriers stand in the way of implementing this technology in the Saudi Arabian governmental procurement system. This study explores drivers and challenges in adopting the e-bidding system for the construction industry in the Saudi Arabian governmental procurement system. Also, evaluating the willingness and readiness of the stakeholders to adopt the e-bidding system. The requirements of the proposed e-bidding system will be identified and collected from stakeholders of government construction industry in Saudi Arabia.

1.2 *Statement of the problem*

The construction industry has huge quantities of information and is one of the most important industries in many countries. Currently, contractors employ handwritten submissions. Saudi governmental authorities request contractors to fill in their offers in pre-printed tender tables. Traditional paper-based tendering is a tedious process because the act of writing is extremely error-prone and in many occasions results in illegible handwriting. Besides that, the possibility of missing the submission deadlines is increased because of possible traffic congestions and accidents that may be encountered (Chan and Chiu, 2007).

Numerous problems emerge during this stage, for example; human errors in production of documents, imperfect information or tender documents, possibility of transposing documents, unclear copies, un controlling of the displayed information in the documents, accidental distribution of confidential information, problems in issuing and confirmation of receipt of the addendums by the bidders (Lou and Alshawi, 2009; Anumba and Ruikar, 2001).

In a big country such as Saudi Arabia with a wide area that resembles Western Europe, it is very difficult for bidders to travel long distances in order to buy tender documents and then submit them. Sometimes contractors have to travel thousands of kilometers to achieve this task. Although it is mentioned in article 10 of the Saudi Competition and Government Procurement System (SCGPS) and article 15 of Implementing Regulations of the Governmental Competition and Procurement (IRGCP) that offers submitted and opened through electronic media are acceptable, it is also mentioned in the same article of the SCGPS and in article 14 of (IRGCP) that bidders are requested to submit their offer in a written format and should be stamped and submitted inside sealed envelopes.

1.3 *Aim of the research*

This research aims to identify the drivers, challenges and the willingness of the Saudi Arabian stakeholders to adopt the e-bidding system (i.e., governmental authorities and contractors).

1.4 *Scope and limitations*

This study will be conducted in the Eastern Province of Saudi Arabia due to the limitations of time and cost, but the findings and conclusions can be generalized to the construction industry in any of Saudi Arabia's provinces due to the similarities of the rules, regulations and business environment.

Because of the above reasons, the words Eastern Province of Saudi Arabia will not be used.

This study will be limited to grade 1 and 2 contractors that are classified by Ministry of Municipal and Rural Affairs in Saudi Arabia. The study focuses on these two classes of contractors because these contractors deal with various types of the governmental projects.

1.5 *Significance of the study*

One of the essential elements of success is to undertake change and implement an innovative way of working while respecting the traditional rules of the industry (Blayse and Manley,2004). In Saudi Arabia, governmental authorities employ a paper-based tendering method. There is a desire to transform the whole process into an electronic tendering system. This is evidenced by the

launching of a web site that sells tendering documents for some governmental competitions as a part of the e-government project. This system is known as MONAFASAT (www. saudiegp.com). E-bidding has been regarded as more cost and time effective method compared to the current traditional paper-based tendering method. Using this method lead to reductions in activities such as printing, copying, courier costs and most importantly a drop in the chances of miscommunication (Tindsley and Stephenson, 2008). Organizations can make the tendering process more economical by shifting from the traditional paper based method to an electronical tendering process (Yang, Ahuja and Shankar, 2007).

Although the Saudi government has taken small steps towards the direction of implementing e-bidding, it still remains slow in adopting and fully implementing the technology for the whole tendering process. Before the technology can be implemented, certain requirements need to be met. These requirements encompass the availability of technology, objectives, information, staffing and skills. These requirements serve to impede the adoption process.

The electronic bidding (e-bidding) is publishing, communicating, accessing, receiving and submitting electronically of all data and documents that related to tender using internet, to replace the traditional paper-based tender processes, and make business process efficient and effective for all stockholders involved (Kajewski, 2001).

The continuing expansion of e-tendering provides opportunities for improving tendering processes. It will make it more efficient and responsive, reduce the reliance on paper based tendering that lead to costs and time reduction and the most important thing that avoiding miscommunication.

CHAPTER 2

Literature Review

2. *Literature review*

2.1 *Traditional tendering process*

2.1.1 What is the traditional tendering process?

Bidding for a construction project is a critical decision for any construction company (Dikmen and Birgonu, 2004). In general, tendering or bidding is a popular basis for choosing a contractor to execute a given construction project (Chinyio, 2011). This process will set the stage for the contractual and regulatory agreements between the major stockholders of the project; the owner (client), consultant team, contractor and other stockholders of the project (Rimmer, 1991). In the construction industry, the tendering stage is considered to be one of the most critical and important stages in the lifecycle of a construction project (Vee and Skitmore, 2003). It comprises several activities and demands a considerable amount of time (Chinyio, 2011). The purpose of the tendering process is to invite bidders to submit their proposals. Subsequently, the tendering authority determines the optimal bid and awards the right to deliver the required service within a specified period of time, under the cover of a legally binding contract, after checking and evaluating each proposal (Dikmen and Birgonu, 2004).

2.2.2 What is the aim of this process?

Competitive tendering enhances the effectiveness by which the market conducts its work which in turn facilitates the government in deciding on who would be the most appropriate service provider. Governments use competitive bidding process for purchasing of goods and services. In general, the main aim of competitive tendering is to engender a competitive atmosphere as a means of motivating service providers so that the level of efficiency may be raised (Rimmer, 1991). For the clients, the aim of competitive tendering is lowering the pre-construction price. For the contractors, the competitive tendering forces them to optimize their use of resources in order to quote a competitive price that will yield profit at the conclusion of a construction project (Chinyio, 2011).

In Saudi Arabia, based on traditional paper-based tendering, the tendering process is conducted in accordance with the SCGPS issued by Royal Decree No. 58 dated 4/9/1427 H that consists of 81 articles. In addition, the tendering process is conducted in accordance with the **'Implementing Regulations' (**IRGCP) issued by the Ministry of Finance Decree no. 362 dated 20/2/1428 H that consists of 155 articles that shows item by item how to implement these SCGPS regulations. Tender documents consist of the invitation to tender, general and special conditions, regulations, drawings, bills of quantities, specifications, addendums and other documents (Public Works Contract model, 1988).

Traditional paper-based tendering necessitates a lot of manual work (Chan and Chiu, 2007). After the tender documentation is completed, it is ready to be issued to interested bidders.

During the tendering stage, contractors are expected to prepare, seal, and submit their proposals to the relevant governmental authority. The government authority then studies and analyzes the proposal page by page in order to find the best proposal for executing the work. This phase is characterized by an astonishing amount of information and data analysis and contain a lot of paper work. (Lou and Alshawi, 2009).

2.2.3 What are the types of problems that emerge during this process?

Contractors are required to use handwritten submission, owing to the fact that they are requested by the clients to fill their offers in pre-printed tender tables. The traditional paper-based tendering process is tedious process because the act of writing is extremely error-prone and in many occasions results in illegible handwriting. Besides that, the possibility of missing the submission deadlines is increased because of possible traffic congestions and accidents that may be encountered (Chan and Chiu, 2007).

There are problems that appear during this stage, for example; human errors in production of documents, imperfect information or tender documents, possibility of mixing up documents, unclear copies, lack of control on the displayed information in the documents, leakage of secret information, problems in issuing and confirmation of the receipt of the addendums by the bidders (Lou and Alshawi, 2009) (Anumba and Ruikar, 2001). All these problems can be minimized if e-tendering is used.

2.2 *Electronic tendering process*

2.2.1 What is the e-tendering process?

To make the government procurement efficient, non-suspicious and reliable, an electronic governmental tendering system must be embraced (Liao, T.S., Wang and Tserng, 2002). At present, technology plays a key role in many businesses, especially in automating the business processes. One of the key business processes in the construction industry is the tendering process. Excessive volume of information are exchanged between clients and contractors in the course of this stage. Given this, in order to realize e-bidding activities, organizations and individuals can use the Internet as platform where they can communicate between each other (Chan and Chiu, 2007).

E-bidding is defined as the process in which tender documents are issued to bidders and received from them in an electronic format (Tindsley and Stephenson, 2008).

This process contains the bid advertisement, production of documents, suppliers registration, electronic submittal of documents between the owner and the contractor, opening of the bid, assessment of submissions and the contract award announcement and publication (Liao, T.S., Wang and Tserng, 2002). Beside these important functions, most e-bidding software provide support such as archiving and document controlling.

2.2.2 What is the aim of this process?

E-tendering is an important tool to increase productivity and empower construction industry professionals to control the tendering process in a better manner (Oyediran and Akintola, 2011). The aim of the process is to minimize the problems that may happen in

traditional paper based tendering. This process is designed as a web-based system in order to perform the evaluation process more effectively (Arslan et al.2008). Besides that, reducing paper work that consumes time to submit and enhancing communication are important goals that would be achieved by implementing e-tendering (Seah, 2004). Contractors complain that sometimes queries are lost or that they receive late answers to queries from the client even after the final submission of the tender documents. Submission and response to queries should be sent electronically to all interested bidders trough the e-bidding system. By using electronic bidding, companies are able to make important decisions and last moment changes over the Internet (Chan and Chiu, 2007).

2.2.3 What are the drivers of this process?

The electronic tender system simplifies the process of obtaining and submitting the documents relative to the original administrative procedures of the traditional paper based tendering. Bidders are able to download tender documents through the internet. In doing so, bidders are able to avoid the paperwork and traditional tendering processes. In addition, governmental authorities can invest less manpower and resources into the production tender documents. Bid conspiracies, which may occur in traditional tendering processes, can also be lessened. This makes it beneficial to the government and bidders who are obedient to the laws. (Liao, T.S., Wang and Tserng, 2002)

The following mentioned drivers are obtained from previous published papers.

Driver factors:

1-Reducing process cost - (bidding process).

2-Reducing transaction administration cost.

3- Reducing administration costs in general.

4- Increasing profit margins (for contractors).

5- Enhancing documents management and archiving.

6- Decreasing expenses by reducing staffing levels.

7- Shortening overall bidding process time consuming.

8- Shortening communication process time consuming.

9- Reducing time by clearer transparency.

10- Reducing evaluation (bid assessment) time.

11- Enhancing quality by increasing competition.

12- Enhancing quality by increasing efficiency.

13- Enhancing quality by improving communication.

These driver factors are explained in depth in the following section.

1-Reducing Process Cost - (Bidding Process):

A survey conducted by the **National Institute of Governmental Purchasing (**NIGP**) in the United State of America** in 2001 found that 75% of the participants were of the opinion that reduction in costs was a driver to adopting E- procurement (Eadie, 2007). According to this same author, this factor fits under the cost category.

2-Reducing Transaction Administration Cost

The use of e-bidding technologies can contribute to savings of up to forty-two percent of transaction costs compared to traditional paper based bidding. This is due to less paper work and a reduction in mistakes (Oyediran and Akintola ,2011).

According to Croom and Johnston (2003), Evans and Wurster (2001) stated that due to the low transaction cost of internet based system, increasingly enables organizations to engage in complex information exchange between many parties. They also introduce the benefits that will be gained by closer relations between stakeholders.

According to Eadie (2010), the most important driver that led to the adoption of e-bidding in the United Kingdom was reducing transaction administration cost. Eadie (2010) categorized this factor under the cost category.

3- Reducing administration costs in general

Implementing an e-bidding system eases the task of reducing administrative costs (Oyediran and Akintola, 2011). This system makes the original administration procedures not only easier but also curtails the overall amount of work. The government of Taiwan and its suppliers were able to save US$14 and US$26 million, respectively, every year (Liao, T.S., Wang and Tserng, 2002).

Researchers have shown that that the reduction of paperwork and administration costs were the 2nd highest driver for the electronic procurement implementation in construction

industry in Canada (Rankin 2006; Eadie, 2007). Eadie (2010) categorized this factor under the cost category.

4- Increasing profit margins (For contractors)

The wide adoption of e-bidding will simplify the bidding process and will increase speed and flexibility and enlarge profit margins for the organizations (Egbu et al 2004). This is due reducing the overhead expenses during the bidding process.

According to Eadie (2010), one of the most important drivers for Wales's organizations to adopt e-bidding is increasing profit margins. Eadie (2010) categorized this factor under the cost category.

5- Enhancing documents management and archiving

In the traditional paper based, documents management and archiving of the large amount of information is paper based. This consumes time and effort of the office employees and necessitates big space and equipment for storing. The replacement of this system with e-bidding will reduce paper work and lead to fast sharing of data and ultimately lead to a reduction in expenses. Moreover, it will reduce time used for double entry of recorded data into electronic data base (Perdomo,2006).

According to Eadie (2010) one of the most important drivers for Scotland's organizations to adopt e-bidding is enhancing documents management and archiving. Eadie (2010) categorized this factor under general category.

6- Decreasing in expenses by reducing staffing levels

Reducing staff is one of important ways to produce competitive advantage by reducing costs. By implementing an e-bidding system, an organization no longer needs to employ more staff.

In one research, it was shown that by implementing an e-procurement system, a steel supplier was able to proceed with a procurement process for a multi-million pound project with only 20% of its procurement staff (Egbu et al 2003). Eadie (2010) categorized this factor under the cost category.

7- Shortening overall bidding process time

According to a survey conducted in the United State of America by **National Institute of Governmental Purchasing (**NIPUSA**)**, 85% of the participants stated that they achieved time reductions through E-Procurement (Eadie, 2007).

Also it has been shown that reduction in time is an important driver for the implementation of e-bidding in the Swedish construction industry (Knudsen, 2003).

Bidding documents could be purchased through the internet. This will also save time as bidders don't have to travel long distances to obtain these documents (Perdomo, 2006). Eadie (2010) categorized this factor under the time category.

8-Shortening communication process time

Since e-bidding uses the internet as the only platform, the only way parties can contact each other is via this platform. This will reduce time and effort wasted by the parties in communicating with each other. Besides that, owner is able to concurrently send documents to all bidders within less time and requiring less effort while also ensuring that all bidders receive documents at the same time (Knudsen, 2003).

According to Eadie (2010), one of the most important drivers for the implementation of e-bidding by Scotland's organizations is the shortened communication process time afforded by this system. Eadie (2010) categorized this factor under the time category.

9-Reducing time by optimising transparency

Transparency is one of the benefits presented to bidders who have adopted an e-bidding system. Panayiotou (2003) argues that the goals of E-bidding can be summarized as: better quality of procedures, reducing cost and time without neglecting transparency. Also, automation of paper work and documentation lead to time reduction and more transparency (Egbu et al 2004).

According to Eadie (2010), the 'reducing time by way of the optimising transparency' driver was ranked No. 4 by Wales's organizations. Eadie (2010) categorized this factor under the time category.

10-Reducing evaluation (bid assessment) time

The implementation of an e-procurement system by the Roads Service Northern Ireland (RSNI) organization simplified and reduced the time needed for the bidding assessment process. Some Roads Service Northern Ireland (RSNI) organization's bill of quantities amounted to more than 2500 items. Typing these items for assessment is a painstaking process. To configure data for typing mistakes, two individuals were required. Bidding assessment evaluation through e-bidding system will lead to large savings in time (Eadie, 2007).

According to Eadie (2010), the 'reducing evaluation (bid assessment) time' driver was ranked No. 4 by Wales's organizations. Eadie (2010) categorized this factor under the time category.

11- Enhancing quality by increasing competition

Wong and Sloan (2003) states that gaining a competitive advantage, reducing procurement cost, and increasing profitability are the most important benefits of electronic procurement. It is seen that e-tendering leads to an increase in the productivity (Eadie, 2007).

Besides that, the adoption of an e-procurement system furnishes the flexibility of performing the procurement whenever it is desired, whether it be 24 hours a day, 7 days a week (Kalakota, 2001; Eadie, 2007). Different offices from any place in the world are able to access the same documents at any time as the main department can control all tendering activities. This feature of an e-procurement system is regarded as a distinct advantage over

the other slower process whereby you're compelled to exchange documents between offices.

According to Eadie (2010), the 'enhancing quality by increasing competition' driver was ranked No. 15 by Scotland's and Wales's organizations. Eadie (2010) categorized this factor under the quality category.

12- Enhancing quality by increasing efficiency

The project cost can't be estimated equally by all bidders. In case where bidders have contact to the same suppliers and subcontractors and at the same time being restricted to the same standards, the project can be assumed as a fixed amount. Therefore the bidder who is ready to lower his expenses in general (including during bidding process) will be the most competitive and lowest one in the bid (Arslan, Tuncan, Birgonul and Dikmen, 2006).

According to Eadie (2010) the 'enhancing quality by increasing efficiency' driver was ranked No. 1 by Scotland's organizations. Eadie (2010) categorized this factor under the quality category.

13- Enhancing quality by improving communication

Data exchanging accuracy has been identified as one driver of e-tendering (Rankin, 2006). The implementation of an e-bidding system facilitates the control of information stream and will guarantee better communication between stakeholders.

According to Eadie (2010), the ‘enhancing quality by improving communication’ driver was ranked No. 3 by the Northern Ireland’s organizations. Eadie (2010) categorized this factor under the quality category.

2.2.4 What are the barriers to e-bidding?

Despite the many advantages of an e-bidding system, there are many barriers to its implementation in the government’s projects sector. Many governments are encouraging governmental sector authorities to convert to e-bidding, but it doesn’t appear to be smooth and the possibility of a successful electronic bidding implementation seems, unlikely, less than the expected (Vaidya, Sajeev and Callender, 2004).

Wong and Sloan (2004) who did a study in the United Kingdom found that only 48% of participants said that they were able to implement electronic commerce in an effective manner.

The following mentioned barriers were obtained from other published papers.

Barrier factors:

1- Staff resistance to change.
2- Lack of technical expertise (Skilled staff).
3- Staff turnover.
4- No development of confidence to use new technologies.
5- Bureaucratic dysfunctionalities.
6- No company access to internet.

7- No legal position of e-bidding- availability of regulations.

8- Insufficient assessment of systems prior to installation.

9- Security in the process - Data transmission to the wrong person – Confidentiality of Information.

10- Tampering with documents - changes to documents.

11- Data transmission reassembly – incorrect reassembly of data transmitted in packets.

12- Partial Data Display - incomplete documents provided.

13- Lack of pertinent case law.

14- Proof of intent - electronic signatures.

15- Clarity of tenderee and tenderer information.

16- Electronic bid evaluation.

17- Top or strategic management commitment for e-bidding.

18- Organizational magnitude of changing management.

19- Lack of national IT policy relating to e-bidding Issues.

20- Lack of flexibility of organization's law and system.

21- Complicated procedures.

22- Cost of information technology investment.

23- E-bidding implementation cost (include system licences).

24- No business benefit realised.

25- Investment in compatible systems.

26- Slow and bad internet service by service providers.

27- Cost of internet service.

These barrier factors are explained in depth in the following section.

1- Staff resistance to change

One of the barriers to the introduction of an e-bidding system is resistant to change. This will slow down the adoption of an e-bidding system and deny the organization the other benefits that may be realized by its adoption (Eadie, 2007).

A survey was conducted on the leading UK construction organizations. Forty one out of fifty six respondents said that resistance to change was the biggest barrier to e-bidding adoption. This represents 73% of the sample (Tindsley and Stephenson, 2008).

According to Eadie (2010), the 'staff resistance to change' barrier was ranked No. 1 by Wales's organizations. Eadie (2010) categorized this factor under the cultural category.

2- Lack of technical expertise (Skilled staff).

Absence of technical skilled staff within the organization is a barrier to e-bidding adoption. Hawking and Stein, 2004, demonstrated that a majority of the e-projects in general are effected by a lack of skilled personnel.

This barrier is related to manpower issues such as senior employees who didn't develop themselves to use IT related systems and who still rely heavily on traditional procurement processes.

According to Eadie (2010), the 'lack of technical expertise' barrier was ranked No. 10 by Wales's organizations. Eadie (2010) categorized this factor under the cultural category.

3- Staff turnover.

The implementation of an e-bidding system has the potential of reducing the number of staff who work for the bidding process. This will lead to an increase in the level of staff turnover. In a research, that explored the benefits of implementing information technology, it was found that contractors had to spend lower than 1% of their staff turnover cost on IT system (Love, Irani and Edwards, 2004).

According to Eadie (2010), the 'staff turnover' barrier was ranked No. 22 by England's organizations. Eadie (2010) categorized this factor under the cultural category.

4- No development of confidence to use new technologies.

The importance of confidence in the use of new technologies is apparent in e-bidding. This is due to high level of uncertainty and risk in most internet based transactions (Du, Foo, Boyd and Fitzgerald, 2004). If staff members lack trust in embracing this new technology, they may not be able to implement the e-bidding system successfully. As this factor is related to cultural issues, so this factor categorized under the cultural category in this research.

5- Bureaucratic dysfunctionalities.

The traditional governmental bidding system and rules have deficiencies. This is clear in developing countries that are characterized by bureaucratic roles and corruption.

There are necessary steps that need to be taken by governments to adopt e-bidding. For example, identification of a legal and organizational framework, making systems for the access and publishing of bidding information.

It is paramount to increase the efficiency of the governmental bidding system in order to make the implementation of an e-bidding system possible (Carayannis and Popescu 2005).

According to Eadie (2010), the 'bureaucratic dysfunctionalities' barrier was ranked No. 10 by Wales's organizations. Eadie (2010) categorized this factor under the cultural category.

6- No company access to internet.

An e-bidding system uses the internet as a platform for its operations. The basic set-up needed to access to this system requires the internet and a web browser. However, some countries like Nigeria face problems with internet access. As reported by Oyediran and Akintola (2011), a limited number of respondents of a survey established that they had internet access. More specifically, 47% of the respondents had internet access. Eadie (2010) categorized this factor under the infrastructure category.

7- No legal position of e-bidding- availability of regulations.

An electronic environment presents visible opportunities for conspiracy between governmental authority and some of tenderers as well as legal uncertainties which may create long term conflicts (Betts, Christensen, Du, Duncan and Gonzalez, 2006).

Although e-bidding system is relatively more efficient system that lowers costs, it exposes its users to many legal obstructions. This is owing to the absence of a law that controls electronic transactions. This keeps the responsibilities of stakeholders undefined, overlapping communication techniques may happened and losing trust in the system (Oyediran and Akintola, 2011). As this factor is related to legal issues, in this study it is categorized under the legal category.

8- Insufficient assessment of systems prior to installation.

Many facilities are needed to implement an e-bidding system. These facilities can be divided into 3 groups: hardware, software and internet/network facilities. Hard ware facilities consist of computer systems and servers to connect computers on the network, and control access to databases. There are software requirements which consists of operating system of the server, operating systems and construction industry professional software. Software facilities may need e-mailing software, e-signature and encryption system for data (Oyediran and Akintola, 2011).

According to Eadie (2010), the 'insufficient assessment of systems prior to installation' barrier was ranked No. 2 by Scotland's organizations. Eadie (2010) categorized this factor under the infrastructure category.

9- Security in the process - Data transmission to the wrong person – Confidentiality of Information.

Security is a major concern while working on the internet. The unprotected use of electronic technology in e-bidding has created un-wanted effects, like the trade-off between efficiency and security. The data exchanged between the stakeholders needs to be encrypted. Another problem is the authentication problem. Authentication is needed to confirm that all data exchanged between stakeholders are done by the designated persons (Chan, Chiu and Hung, 2007).

According to Eadie (2010), 'Security in the process - Data transmission to the wrong person' barrier was ranked No. 1 by Wales's organizations and the 'confidentiality of information' barrier was ranked No. 2 by Northern Ireland's organizations. Eadie (2010) categorized this factor under the security category.

10- Tampering with documents - changes to documents.

Transactions are very important in the case of legal problems, issues and claims during the project. These transactions might not be secured from intentional and unintentional tampering during the process of exchanging on the internet platform. In traditional paper-based transactions, multiple copies of documents can prevent a particular stakeholder from tampering transactions data to his own benefit.
Besides that, broken seal in an envelope may indicate that somebody tried to tamper documents to his own benefit.

In e-bidding system, users have concerns about how to prevent and discover tampering attempts during and after the transmission of the information (Feniosky and Choudary, 2001).

According to Eadie (2010), the 'Tampering with documents - changes to documents' barrier was ranked No. 1 by Scotland's and Northern Ireland's organizations. Eadie (2010) categorized this factor under the security category.

11- Data transmission reassembly – incorrect reassembly of data transmitted in packets.

In order to understand data transmission and reassembly, the process of I.P. (Internet Protocol) and T.C.P. (Transmission Control Protocol) need to be explained.

I.P. delivers data from one computer to another each with its own unique I.P. address. This Protocol divides messages into data packets and affixes. The I.P. address of both the sender and receiver each packet. Packets are sent across network through various gateways by different routes and are often received by T.C.P. in different order than originally sent. T.C.P. is necessary for the reassembly of packets into the original message so that the receiver can obtain the whole message.

The problem is that no transmission can be 100 % reliable. T.C.P. may not be able to recover packet losses from one system to another. Success and failure of data recovery depends on something called time delay. T.C.P. retransmit packets and wait for replies or acknowledgement that they are carried in reverse packet stream. If the

acknowledgement is not received, the packets will be retransmitted. The retransmission of these data packets may result in duplications.

Disruption may happen within each network communication due to unrecoverable packets or missing data (Cref and Khan, 2005).

According to Eadie (2010), the 'data transmission reassembly – incorrect reassembly of data transmitted in packets' barrier was ranked No. 6 by Northern Ireland's organizations. Eadie (2010) categorized this factor under the security category.

12- Partial data display - incomplete documents provided.

In e-bidding system, all the bidding documents are downloaded through the internet platform. Without a way to ensure that every bidder has the same displayed bidding documents, there will a lot of concerns in the adoption of an e-bidding system. This problem of display could happen due to incompatible software (Chan & Chiu, 2007).

According to Eadie (2010) the 'partial data display - incomplete documents provided' barrier was ranked No. 6 by Northern Ireland's organizations. Eadie (2010) categorized this factor under the security category.

13- Lack of pertinent case law.

One of the challenges faced in the implementation of an e-bidding system is changing the functionality of the paper –based bidding to e-bidding with maintaining legal commitments with the existing lack of experience and the priority of legal laws.

The e-bidding technology is comparatively new, so the law has not yet changed effectively to an electronic transaction enforcement (Lavelle and Bardon, 2009).

According to Eadie (2010) the 'Lack of pertinent case law' barrier was ranked No. 9 by Scotland's organizations. Eadie (2010) categorized this factor under the legal category.

14- Proof of intent - electronic signatures.

The use of electronic signature is important for all electronic transaction. It is used as proof of intent and to ensure a secure transmission process. However, there are security concerns with using e-signature.

The security concerns identified by researchers are with respect to the private key of digital signature and the passwords being an insufficient means of protecting a private key as users generally use passwords that are easy to guess, forget to change passwords at regular periods of time, or create a secured private key with a password that can be attacked easily (Srivastava, 2009).

According to Eadie (2010), the 'Proof of intent - electronic signatures' barrier was ranked No. 1 by Wales's organizations. Eadie (2010) categorized this factor under legal category.

15- Clarity of tenderee and tenderer information.

The communication problems faced by users of electronic transmission relate to the accuracy and clarity of transmitted information. As mostly, project information received is not usually timely, accurate and clearly expressed (Danny, 2001). Besides that, there is an increased possibility of identity fraud which is the fake adoption of another person's identity. Any person who uses the private key of another individual or organization to submit a bid is faking the person identity who is authorised to use it with deceive intent (Christensen, Sharon and William, 2006). According to Eadie (2010), the 'clarity of tenderee and tenderer information' barrier was ranked No. 13 by Northern Island's organizations. Eadie (2010) categorized this factor under legal category.

16- Electronic bid evaluation.

As e-bidding is based on electronic transmissions which suffers from problems of the accuracy and clarity of transmitted information (Du, Foo, Boyd and Fitzgerald, 2004), beside the security concerns in relation to proof of identity and legalisation, the level of trust of the bid evaluation process will be dominated by many concerns. As this factor is related to legal issues, it can be categorized under the legal category.

17- Top or strategic management commitment for e-bidding.

If there is no support from the top management, who has to ensure that the implementation of an e-bidding system results in an increase in productivity and

efficiency, e-bidding implementation will be confronted with major problems. Prior to e-bidding implementation, employees need to be trained on how to use the new system and all the relevant resources needed for the proper functioning of the system need to be procured.

These things will not be available to the employees and the organization without support from the upper management (Lou and Alshawi, 2009).

According to Eadie (2010), the 'Top or strategic management commitment for e-bidding' barrier was ranked No. 9 by Scotland's organizations. Eadie (2010) categorized this factor under the cultural category.

18- Organizational magnitude of changing management.

More changes in bidding process can be expected, since implementing new technology. So there will be big changes to business practices and the structure of organizations as e-bidding becomes implemented.

Seger in 1999 said 'a change in rules, polices and business process is necessary'' to implement e- bidding successfully. Without a positive attitude towards the change of these rules by the upper management, e-bidding cannot be implemented (Kheng and Hawamdeh, 2002). According to Eadie (2010), the 'Organizational magnitude of changing management' barrier was ranked No. 1 by Wales's organizations. Eadie (2010) categorized this factor under the cultural category.

19- Lack of national IT policy relating to e-bidding issues

An effective national IT policy pave the way towards the successful implementation of e-bidding. But with lack of effective national IT policy and programmes to encourage the spreading of information technology, as it is the base of e-bidding implementation in both governmental and private sectors, people will face problems in introducing e-bidding (Yap, Thong and Raman, 1994).

According to Eadie (2010), the 'Lack of national IT policy relating to e-bidding issues' barrier was ranked No. 1 by Wales's organizations. Eadie (2010) categorized this factor under the cultural category.

20- Lack of flexibility of organization's law and system.

In order to implement e-bidding, simplified and flexible laws framework need to be established by clarifying aspects which are considered to be obstacles or complicated and modify the rules in force that may generate problems that shown as it can't be solved through interpretation of terms (Carayannis and Popescu, 2005).

According to Eadie (2010), the 'Lack of flexibility' barrier was ranked No. 7 by England's organizations. Eadie (2010) categorized this factor under the cultural category.

21- Complicated procedures.

One of the shortcomings inherent in e- bidding is in connection to complicated procedures. This problem will affect the adoption of e-bidding and thus bar the attainment of many benefits (Eadie, 2007).

There is no recognised quantifiable way to measure the benefits of implementing information technology systems with all its complicated procedures in organizations (Lou and Alshawi, 2009).

According to Eadie (2010), the 'complicated procedures' barrier was ranked No.10 by Wales's organizations. Eadie(2010) categorized this factor under the cultural category.

22- Cost of information technology investment.

Although the cost of information technology is going down, suitable information technology infrastructure constituted a barrier in the adoption of e-bidding. This infrastructure includes hardware and software. Both of them will offer secure electronic transactions to the stakeholders. But the problem arises from the cost of developed hardware and software.

Another important problem is the high cost of operation and maintenance of such infrastructure, this represents additional financial barrier (Ebrahim and Irani, 2005).

According to Eadie (2010), the 'cost of information technology investment' barrier was ranked No. 1 by Wales's organizations. Eadie (2010) categorized this factor the cost category.

23- E-bidding implementation cost (include system licences).

Shifting to and implementing e-bidding is a very costly commitment and mandates a significant investment by an organization. These investments are necessary to automate this process. It needs initial investments for the needed infrastructure, training of employees and interoperability of distributed software and licences over internet (Mose, Njihia and Magutu, 2013).

Also, contractors may have to absorb the cost of printing documents for analysis purposes and hire special employees to operate plotters and CAD software (Tindsley and Stephenson, 2008). As this factor is related to cost issues, it is categorized under the cost category.

24- No business benefit realised.

This is the barrier where the organization perceives the cost of shifting to an electronic procurement system exceeds the potential benefits (Egbu et al 2004). A study conducted in Northern Ireland concluded that many contractors were unaware of the huge benefits that the introduction of an e-procurement system could bring (Eadie, 2007).

According to Eadie (2010), the 'No business benefit realised' barrier was ranked No. 27 by Wales's organizations. Eadie (2010) categorized this factor under the general category.

25- Investment in compatible systems.

Exchanging procurement information through the web leads to interoperability concerns. This is a consequence of some software companies choosing to have their products unique. They program their software in a way that precludes the migration of data between systems. So, there need to invest in compatible systems and software to be able to implement e-bidding system. The compatibility, interfacing between other systems and stability are technical issues which have become barriers to e-procurement implementation (Rankin 2006; Eadie, 2007).

According to Eadie (2010), the 'Investment in compatible systems' barrier was ranked No. 2 by England's organizations. Eadie (2010) categorized this factor under compatibility category.

26- Slow and bad internet service by service providers.

Although the internet speed in kingdom of Saudi Arabia is fast, users may not able to realize what they subscribed for. This is because of the proxy limitations in Saudi Arabia. One interviewed citizen, who is a resident of a city in the Eastern Province of Saudi Arabia, observed that, "The Internet speed is slow even if you order a high speed connection. We feel that there is a high load on the Internet". The slowness of internet services makes the experience of working on the internet platform unbearable and unproductive (Alied, Rogerson and Fairweather, 2009). As this factor is related to infrastructure issues, it can be categorized under the infrastructure category.

27- Cost of internet service.

Internet cost in Saudi Arabia is really expensive in comparison to other countries (Alied, Rogerson and Fairweather, 2009). This is one of the financial barrier that will have an impact on the implementation of an e- bidding system. Alied, Rogerson and Fairweather (2009) published a table [2.1] (shown below) that indicates that the internet prices in Saudi Arabia and some other developing countries exceed those of the United Kingdom. As this factor is related to cost issues, it is categorized under the cost category.

Table 2.1: Internet service prices in January 2009

Sources (Amf.org.ae, dol.gov, du.ae, etisalat.ae, orange.jo)

Country	Internet Speed							Gross Domestic Product Per Capita £=5.3SR
	128KB	256KB	512KB	1 MB	2 MB	8 MB	16 MB	
KSA	£19	£27	£36	£54	£83	£152	£174	£9,900
UAE	N/A	£27	£34	£45	£63	£109	N/A	£26,000
Jordan	£16	N/A	£20	£28	£37	£56	N/A	£1,700
Egypt	N/A	£11	£18	£31	£50	£105	£186	£1,000
UK	N/A	N/A	N/A	N/A	£4.5 or free	£4.5	£10	£21,000

2.2.5 Current situation in Saudi Arabia.

In Saudi Arabia, governmental authorities still use paper-based tendering method. Although it is mentioned in article 10 of the SCGPS and article 15 of (IRGCP) that offers submitted and opened through electronic media are acceptable, it is also mentioned in the same article of the SCGPS and in article 14 of (IRGCP) that bidders are requested to make

their offer in a written format in the original forms that are provided by the governmental agency and should be stamped and submitted enclosed in a sealed envelopes.

There appears to be a desire to change the whole traditional paper based process in to electronic bidding. This is clear by the launching of a web site that sells tendering documents for some governmental competitions as a part of e-government project. This system is referred to as MONAFASAT (www. saudiegp.com). The aims of this system as mentioned in the web site are:

1- Automating the governmental procurement and tendering procedures.
2- Unification of governmental procurement procedures and establish unified standards.
3- Develop the procedures in order to enhance the procuring process and contracting under the umbrella of the Saudi competition and government procurement system. The aim of this to increase the level of performance and effectiveness of the process.
4- Enhance monitoring and auditing of the procurement process.
5- Enhance the economic return through saving time, effort and expenses.
6- Enhance the spirit of justice, transparency and participation in combating financial and administrative corruption.
7- Continuous cooperation, communication, participation and exchange of data and information between government agencies, as well as the private sector.
8- Promote the use of e- government transactions.

2.3 Previous studies in other countries

The bidding stage in the construction industry is considered to be one of the most critical and important in the lifecycle of the construction project. It contains several activities and consumes a considerable amount of time. E-bidding is an important tool to increase productivity and empower construction industry professionals to control the tendering process in a better manner. There is a shortage of empirical studies on the adoption of e-tendering in Middle Eastern region.

Similar previous studies conducted in 6 other countries will be discussed. The objective and findings of each study will be shown. These studies were conducted in the United Kingdom, Federal Republic of Nigeria, Northern Ireland, Hong Kong, and the Republic of Malawi.

2.3.1 E-Tendering Process within Construction: A UK Perspective

The objective of this research, which was undertaken by Tindsley and Stephenson (2011), was to show the status and effectiveness of e-tendering within the UK construction context.

Results were obtained from an industry survey that contained both quantitative and qualitative data. A case study was included that assessed the use of e-tendering software in practice. The results of the research showed that e-tendering can make resource savings to a big part of the supply chain. This is through application of e-bidding that will enhance communication, increases time savings and reduces costs. However, a considerable percentage of the industry remains uncertain about introducing new technologies, with resistance to change considered to be one of the greatest barriers. The results showed that many managers within the UK construction industry advocating the implementation of e-tendering. The results also showed that training, education and

support from higher management are important factors in the wide implementation of e-tendering.

2.3.2 A Survey of the State of The Art of E-Tendering in Nigeria

The objective of this research was to assess the state of the art of e-tendering in the Nigerian construction industry. In the research design, Oyediran and Akintola (2011) used a cross-sectional type survey, where data was collected from cost estimators, architects, engineers, and contractors in the construction industry. Out of 109 questionnaires that were distributed, they received 66 responses. The results of this survey showed an essential level of knowledge about e-tendering existed among the professionals who operate the Nigerian construction industry. The research showed a general shortage of crucial facilities necessary for the e-tendering process and a lack of knowledge in their usage. Power supply problems, cost of establishing e-tendering infrastructure and old telecommunications infrastructure are major barriers in the implementation of e-tendering systems. Other barriers included: weak legal support for electronic trading, poor government effort in establishing an electronic trading and tendering portals. Despite e-tendering implementation resisted by some of the industry's stakeholders, the possibility is very high to adopt it in the Nigerian construction industry.

2.3.3 The Adoption of Electronic Procurement in Singapore

This research, which was conducted by Kheng and Al-Hawamdeh (2002), showed the impact of the new technology on the purchaser side of the procurement process. It also showed that the adoption of an e-procurement system enhances an organization's competitiveness.

The results were obtained from a survey designed to gain insight into the impacts the adoption of e-procurement had on a companies situated in Republic of Singapore. Specifically, the research showed the benefits and the barriers of the adoption of electronic procurement in Singapore.

2.3.4 Drivers and Barriers to Public Sector E-Procurement within Northern Ireland's Construction Industry.

This research was conducted by by Eadie, Perera , Heaney and Carlisle (2007). The findings of the study showed the drivers and barriers of e-procurement in Northern Ireland's construction industry. Seventy contractors specialized in Roads Service in Northern Ireland (RSNI) biddings ranked drivers and barriers of e-procurement. The RSNI is one of the big governmental clients in Northern Ireland and is responsible for roads. The results of this research were compared with other researches on e-procurement conducted in Australia and America. The finding showed that enhancing communication and minimizing administration costs were the top ranked drivers while the top ranked barriers were transactions security and the lack of legal support issues of e-procurement.

2.3.5 Adoption of e-procurement in Hong Kong: An empirical research

This research was conducted by Gunasekaran, A., and Ngai, E. W. (2008). The goal of this research was to identify the factors that contributed to a successful implementation of an e-procurement system. A conceptual framework of the adoption of e-procurement was developed in this research. This framework was verified with the use of data collected from different companies across Hong Kong. In addition to this, this research showed the situation of e-procurement adoption in Hong Kong. In the end, the research proposed a framework on the basis of the conceptual and empirical analysis for e-procurement adoption. The findings showed that sufficient financial support, support and earnest commitment from high level management, and having tight security systems in place were the main factors of a successful implementation of an e-procurement system.

2.3.6 Electronic Tendering in the Malawian Construction Industry: The Dilemmas and Benefits

This research was conducted by Chilipunde (2013). The results of the research showed the barriers to the full implementation of e-tendering. It also listed and assessed the drivers of implementing e-tendering technology. Furthermore, it outlined the problems of the traditional paper-based bidding system. To achieve the foregoing goals, data was collected from Cost Estimators, Architectural and Engineering organizations as well as the Roads Authority. In all, thirty-seven consultants participated in the survey. The survey highlighted the problems of traditional paper-based tendering system. With

respect to e-bidding system, it highlighted the barriers faced and benefits realized from successful implementation. Finally, the researcher recommends informing the stakeholders of the Malawian construction industry about the merits of e-bidding by underlining the problems of the traditional paper-based tendering system. The researcher also recommends start overcoming the barriers of implementing e-bidding system.

CHAPTER 3

Methodology of the Study

3. Methodology of the Study

3.1 Introduction

This chapter outlines the procedure that was adopted to reach the objective of this research. It consists of the following steps: (1) The identification of drivers and barriers of e-bidding through literature review, (2) Development of survey questionnaire and interviews for data collection, (3) Population identification and sampling, (4) Data analysis and presentation and discussion of findings and conclusion.

3.2 Research Strategy

The research procedure that was followed can be summarised in the following 4 stages:

1. Identification of drivers and barriers of e-bidding through literature review.
2. Data collection.
3. Population and sampling.
4. Data analysis and presentation of results.

3.2.1. **Identification of drivers and barriers of e-bidding through literature review**

The factors that impact adoption of e-bidding were divided into two broad sections. These are the factors which will decide whether the implementation of e-bidding will be successful or not. Depending on their effects, these factors can be driver factors that promote or barrier factors that impede the implementation of e-bidding. Those factors that have a positive impact will be marked as drivers and factors that have negative impact will be marked as barriers.

The factors obtained from previous studies were related to e-government, e-commerce, e-procurement, e-buying, e-trading, e-auction, e-bidding and e-tendering.

3.2.2. **Data collection**

A survey was used to evaluate the barriers, challenges and willingness to adopt the e-bidding system. Respondents to the survey included contractors and governmental agencies in the Eastern Province of Saudi Arabia. The bidding personnel and project managers were requested to fill the survey questionnaire. This was through e-mails and face to face interviews.

3.2.2.1 **Questionnaire design and scoring system**

A questionnaire was designed and attached to the covering letter in order to be submitted to contracting companies and governmental authorities. This letter revealed the objectives of the research and explained to the participants that the findings of the questionnaire would be used to show the Saudi Arabian government the importance, willingness of stakeholders to adopt the system and barriers faced in the implementation of e- bidding in governmental projects sector.

The questionnaire consisted of seven sections. These are presented below:

1. **The organization's profile**: This section contains questions related to the profile of the organization such as age, size and value of projects under execution or owned by the organization, number of tendering department employees, value of projects currently under bidding, location, contracting firm capital, contractor grade etc.

2. **The respondent's profile**: This section contains questions related to the respondents such as educational level, job title, experience etc.

3. **Survey of the driving factors that affect e-bidding adoption**: This section contains potential driving factors that may have an affect on e-bidding adoption. Respondents were requested to indicate the degree to which these factors have an effect on an organizations ability to adopt e-tendering by placing a tick (√) in the appropriate box in a scale of 1 to 5 where 5 represents a very high effect and 1 represent no effect.

4. **Survey of the barriers that affect e-bidding adoption**: This section contains what were assumed to be potential barriers that may have an affect on e-bidding adoption. Respondents are requested to indicate the degree to which these factors have an effect

on an organizations ability to adopt e-tendering by placing a tick (√) in the appropriate box in a scale of 1 to 5 where 5 represents a very high effect and 1 represent no effect.

5. **Survey of the organization's readiness for e-bidding**: This section contains what were assumed to be the major elements of an organization that determined its level of readiness in adopting e-bidding. The respondents were requested to indicate the level of readiness of these elements by placing a tick (√) in the appropriate box in a scale of 1 to 5 where 5 represents a very high ready and 1 represent not ready.

6. **Survey of the construction industry's readiness for e-bidding**: This section contains what were assumed to be the major stakeholders of the construction industry that determined its level of readiness to adopt e-bidding. The respondents were requested to indicate the level of readiness of these stakeholders by placing a tick (√) in the appropriate box in a scale of 1 to 5 where 5 represents a very high ready and 1 represent not ready.

7. **Proposal for any other barriers or driving factors affect e-bidding adoption**: This section provided the respondents an opportunity to propose any other barriers or driving factors that they believed affected the adoption of e-bidding.

Finally, the contact information of the researcher was included in the cover letter in case the respondent was interested in reaching the researcher to learn about the findings of the study. Appendix 1 presents the developed questionnaire.

The first two parts of the questionnaire did not require any sort of scoring system as it shows the profile of the organization and respondent who participated in the study. Scoring system is needed in parts 3, 4, 5 and 6 as the usage of scoring system is needed in the calculation of weighted scores to determine the ranks of the factors and elements.

3.2.3. **Population and sampling**

A list detailing all governmental authorities that have bidding sections, hundreds of projects, and various types of projects under tender with various cost, nature and size in the Eastern Province of Saudi Arabia was prepared. The approximate number of the governmental authorities that are involved in bidding activities, at the time of writing, in the Eastern Province of Saudi Arabia is around 15. Therefore, questionnaires were sent to all of them. Similarly, another list detailing all grade one and two contracting companies based in the Eastern Province of Saudi Arabia according to the classification by Contractors Grading Agency of the Ministry of Municipality and Rural Affairs was prepared. Since the total number of grade 1 and 2 construction contractors in Eastern Province of Saudi Arabia were 51, the sample size for the construction contractors that would reflect the population of the region was calculated based on Kish formula

$n^o = (p*q)/ v2$

then, $n = n^o / [1 + (n^o / N)]$

n^o is the first estimate of sample size

p is the proportion of the characteristic being measured in the target population

q = 1-p v which is the maximum percentage of standard error allowed

N is the population size

n is the sample size for the purpose of getting the maximum sample size.

The values of (p) and (q) will be considered as 0.5 for both. The maximum standard error allowed (v) in this study will be considered as 10%. The total population as per (Appendix 2) Applying the above formula, the sample size is: $n^o = (0.5 * 0.5)/ (0.1)2 = 25$

This gives n = 25/ [1 + (25/51)] = 16.77. Rounding up this figure gives approximately 17 contractors but for the purposes of this study this figure was increased to 20 contractors.

From this previous figure, the minimum required response rate was determined to be (20/51) * 100 = 39.2 %. The sample by its nature included a rich mix of company sizes. The required data for this research was collected from the higher management and personnel of the contracting firms and governmental organizations who were responsible or involved in issuing, receiving, producing, filling and dealing within the tendering stage.

For the governmental authorities, the minimum sample required is as per the following:

N = 25/ [1 + (25/15)] = 9.38 Rounding up this figure gives approximately 10 governmental authorities but for the purposes of this study this figure was increased to 12 governmental authorities.

From this previous figure, the minimum required response rate is (12/15) * 100 = 80 %

3.2.4. **Data analysis and presentation of results**

Data collected from the questionnaire was analysed and used to identify the significant driving and barriers factors that may affect e-bidding adoption in the public sector of Saudi Arabia's construction industry.

Statistical methods were applied to explain the results. The analysed data is presented in both tabulated format and figures. Graphical representation is a powerful tool for making comparisons clearer and thus was used for showing the barriers and drivers factors' ranking levels from the perspective of each group of participant's (contractors and governmental authorities).

3.2.4.1. **Importance index**

There are 13 potential driving factors that may affect e-bidding adoption and another 27 potential barriers that may affect e-bidding adoption. The importance of these factors was calculated using the following formula (Abdul-Hadi, N. H., 1990):

$$\text{Importance Index} = \sum(a*X)*100/5$$

a: constant expression that denotes the weight given to each response. The weight ranges from 1 to 5 where 1 is least important and 5 is most important.

X= n/N

n= Response frequency.

N= Total number of responses.

3.2.4.2. **Factor significance**

After calculating the importance index of all the factors and readiness elements from both parties, the range of the importance index is arranged in ascending order of important index and divided into classifications that identify the level of significance of the factors.

3.2.4.3. **Level of readiness**

In a similar fashion to the level of significance, after calculating the importance index of all the factors and readiness elements from both parties, the range of the importance index is arranged in ascending order of important index and divided into classifications that identify the level of readiness of the elements.

3.2.4.4. **Correlation**

The correlation between the participated parties was calculated using Pearson correlation test and Spearman's Coefficient Rank correlation.

3.2.4.4.1. **Pearson correlation test**

The Pearson correlation test is calculated based on the importance index according to the following equation:

$$r = \frac{\mathrm{cov}(X, Y)}{\sigma_X \sigma_Y}$$

Where: r = sample correlation coefficient.

COV (X,Y) = sample covariance.

σ_X = sample standard deviation of X.

σ_Y = sample standard deviation of Y.

3.2.4.4.2 **Spearman's coefficient rank correlation**

The Spearman's coefficient rank correlation is calculated based on the ranks according to the following equation:

$$r_s = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}.$$

Where: r = sample correlation coefficient.

d = the difference between the two ranks of each observation.

n = the number of observations.

3.2.4.4.3 **Test of hypothesis**

The T- test for independent samples to verify the agreement or disagreement between the parties. It tests the null hypothesis that there is an agreement between contractors and governmental authorities or disagreement.

By carefully studying the results of the survey, a better understanding of the current situation of e-bidding in the construction industry of Saudi Arabia was gained. This insight aided in recommending the next approach for further studies of the subject.

CHAPTER 4

Analysis of the Results

4.1 *Introduction*

In this chapter, results gained from survey questionnaire are presented in the form of tabular columns, graphs and percentages. Table 4.1 shows the percentage of the contractors and governmental authorities who participated in this study.

Table 4.1: Percentage of the contractors and governmental authorities who involved in this study

Respondents	**Number**	**Percentage**
Contractors	20	62.5 %
Governmental Authorities	12	37.5 %
Total	32	100%

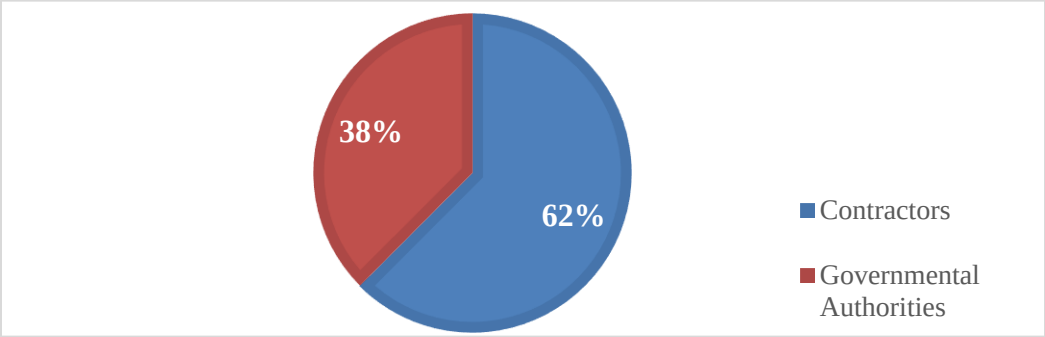

Figure 4.1: Percentage of the contractors and governmental authorities who involved in this study

4.2 *General information*

In this part, general information relating to the organizations and participants are outlined as follows:

4.2.1 *General information regarding the organization*

The organization's age in years are categorized as below:

1. Very old: Equal to or more than 25 years.
2. Old: 20 to less than 25 years.
3. Moderate: 15 to less than 20 years.
4. Young: 10 to less than 15 years.
5. Very Young: 5 to less than 10 years.
6. New: less than 5 years.

The distribution of the contracting organization's age is given in Figure 4.2. "Very old", the category that accounts for the biggest share of the distribution, represents 60% of all the contracting organizations that participated. "Old" and "moderate" are in second place with 15% of contractors. Figure 4.3 shows the percentages of each category.

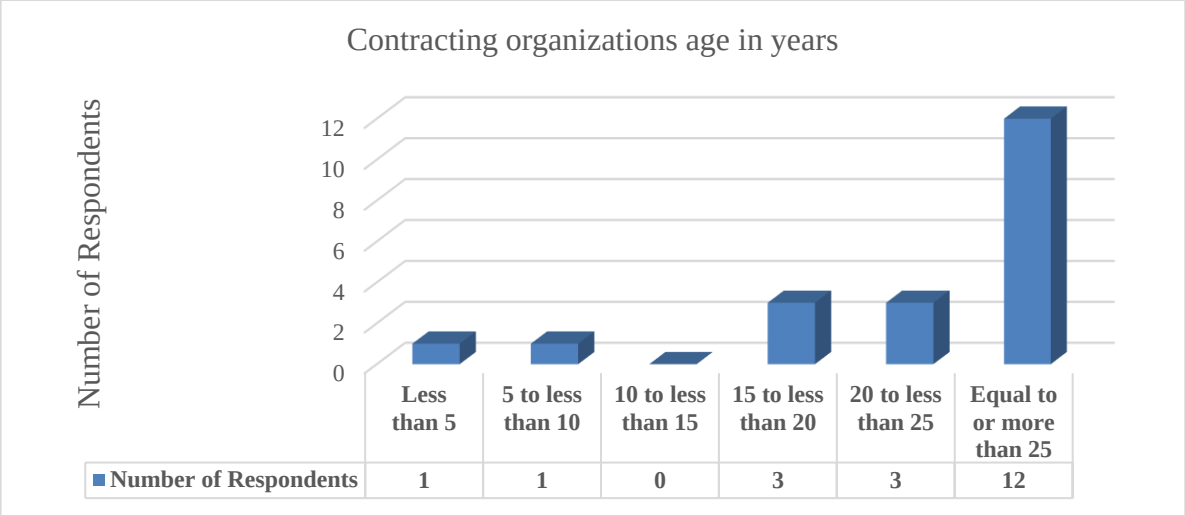

Figure 4.2: Contracting organizations age in years

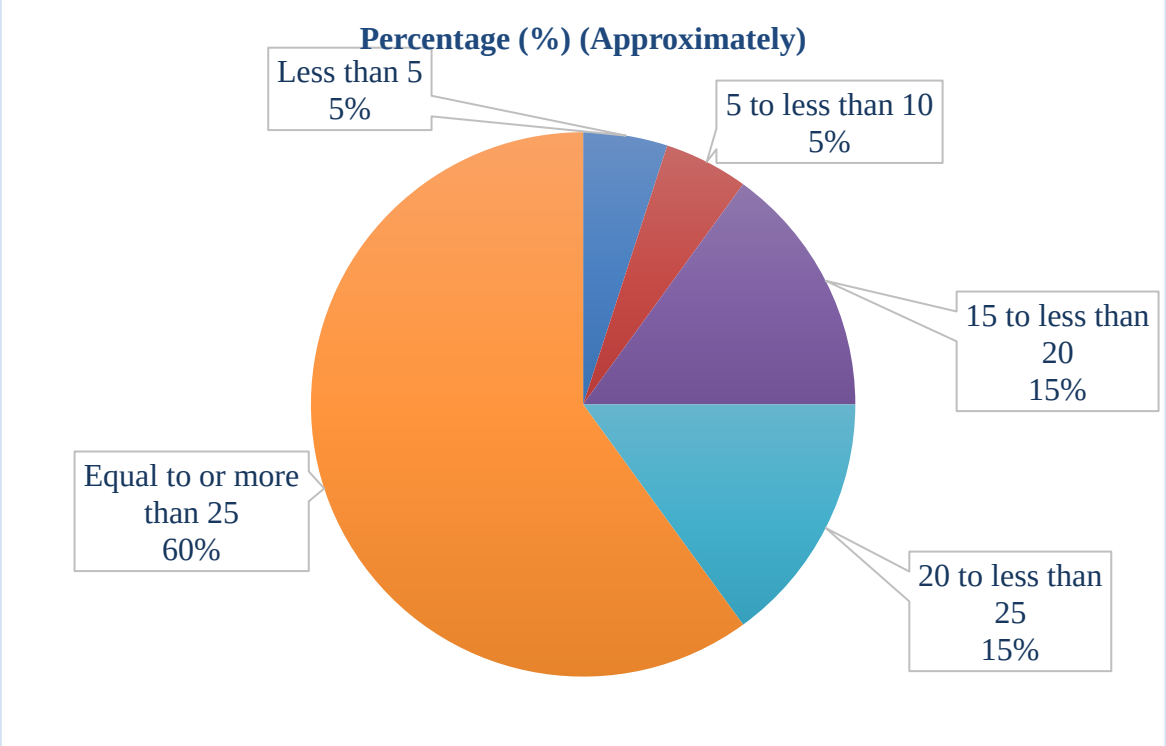

Figure 4.3: Contracting organizations age in years– percentage

The number of bidding department employees are categorized as below:

1. Extremely big: Equal to or more than 25 employees.
2. Very big: 20 to less than 25 employees.
3. Big: 15 to less than 20 employees.
4. Moderate: 10 to less than 15 employees.
5. Small: 5 to less than 10 employees.
6. Very small: less than 5 employees.

The distribution of contracting organizations with a certain number of employees in the bidding department (corresponding to the 6 categories mentioned above) is given in Figure 4.4. “Small”, the category that accounted for the biggest share of the distribution, represented 45% of the contracting organization. “Very small”, “moderate” and “extremely big” were all tied in in second place with 15% of contractors. Figure 4.5 shows the percentages of each category.

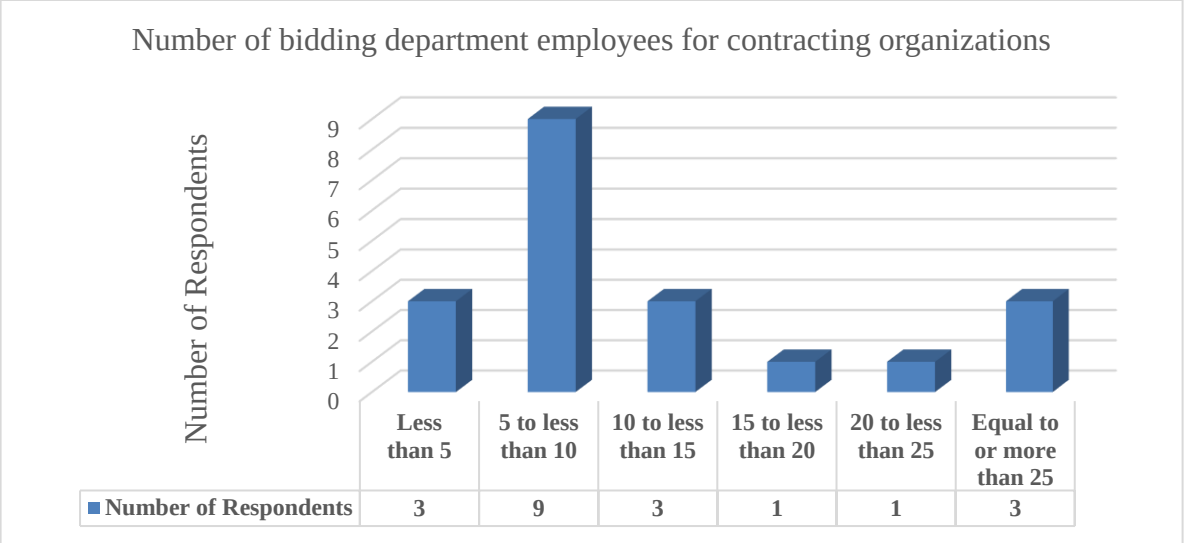

Figure 4.4: Number of bidding department employees for contracting organizations

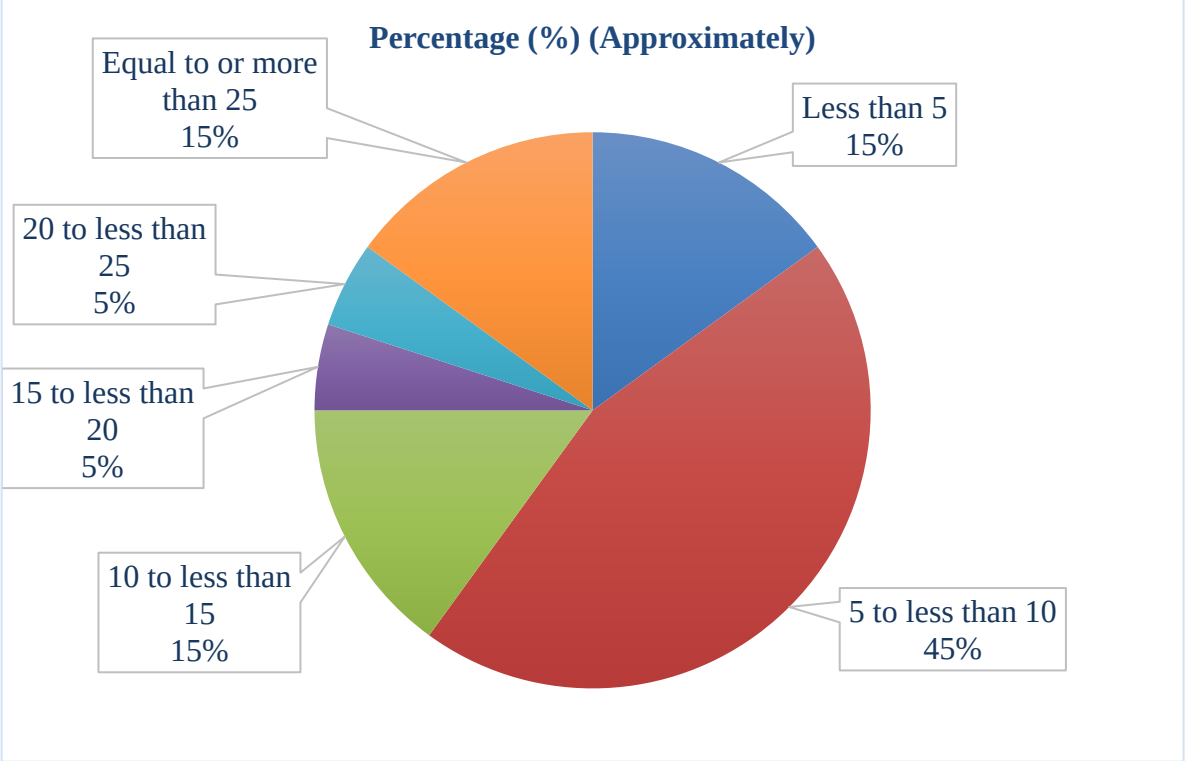

Figure 4.5: Number of bidding department employees for contractors - percentage

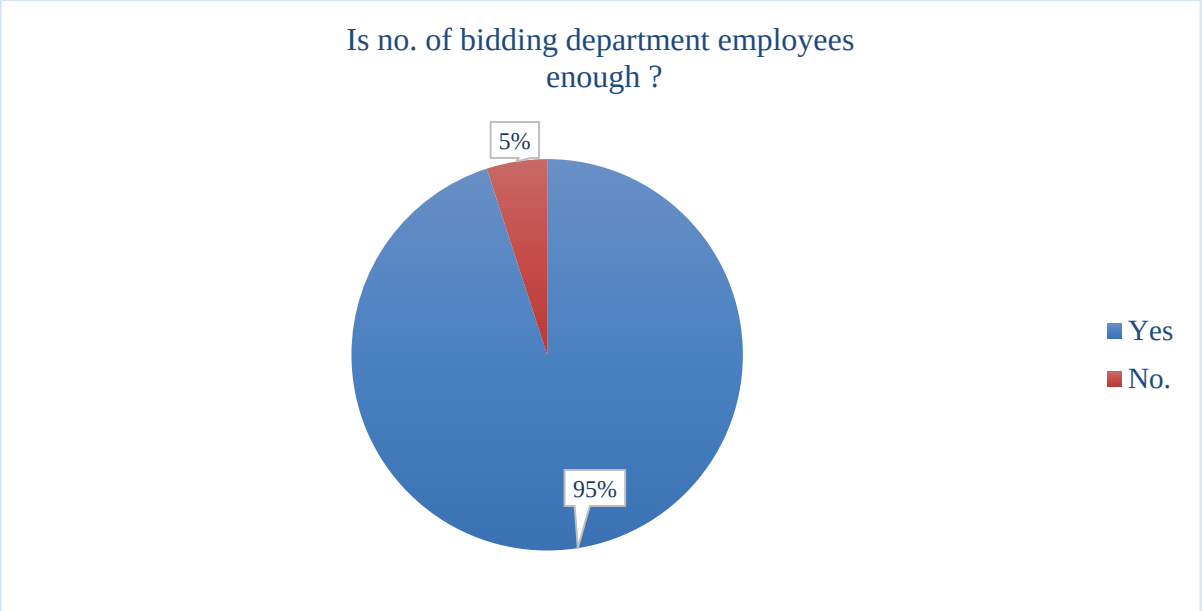

Figure 4.6: Bidding department employees' number (enough or no).

The contracting organizations' respondents were asked if the number of bidding department employees their organization had was sufficient. Ninety-five percent of the respondents answered in the affirmative and only 5 % answered in the negative. The result is shown in Figure 4.6.

The distribution of governmental authorities with a certain number of employees in the bidding department (corresponding to the 6 categories mentioned previously) is given in Figure 4.7. The respondents from the governmental authorities are distributed equally between “moderate”, “big”, “very big” and “extremely big”. Figure 4.8 shows the percentages of each category.

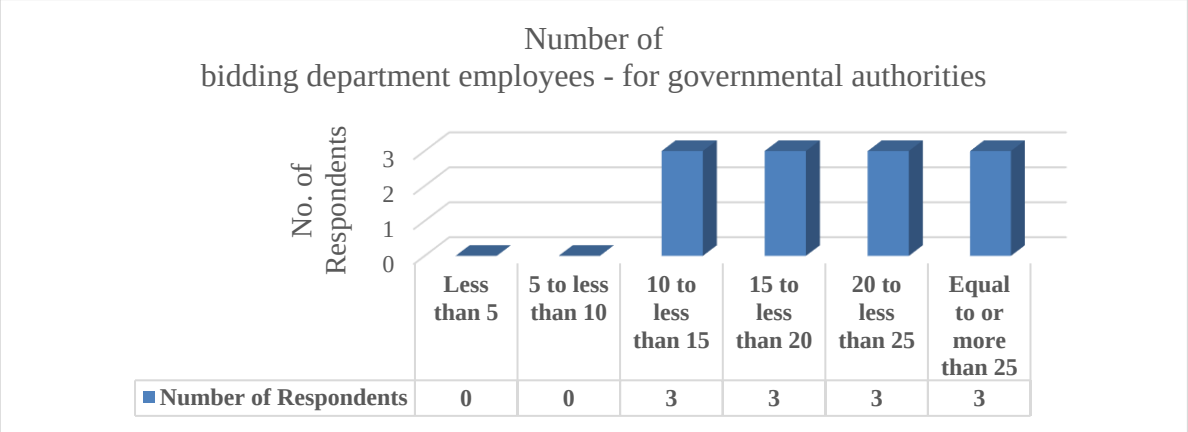

Figure 4.7: Number of bidding department employees for governmental authorities

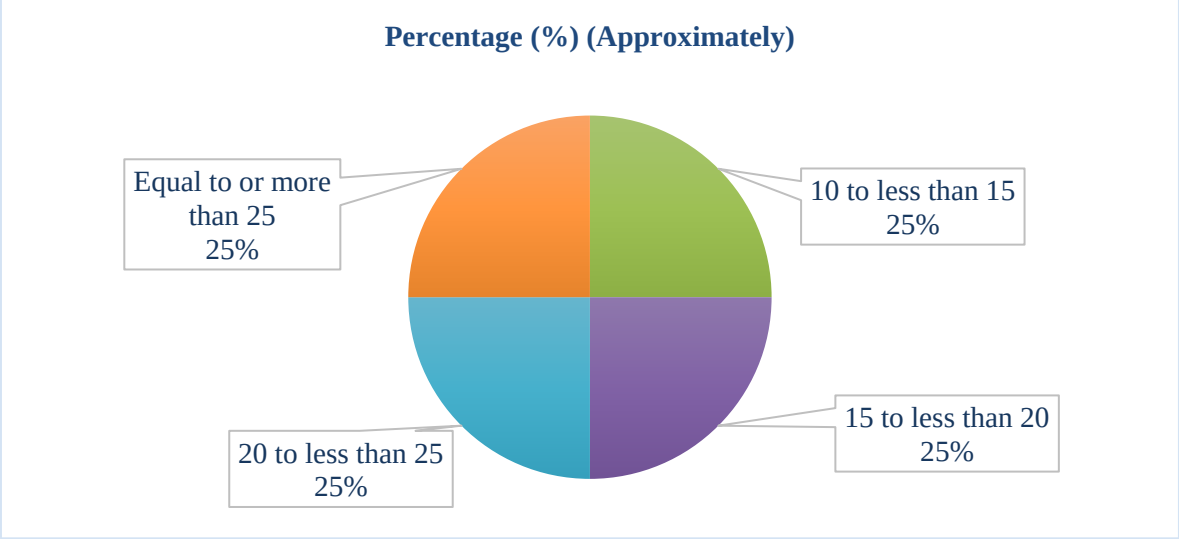

Figure 4.8: Number of bidding department employees for governmental authorities - percentage

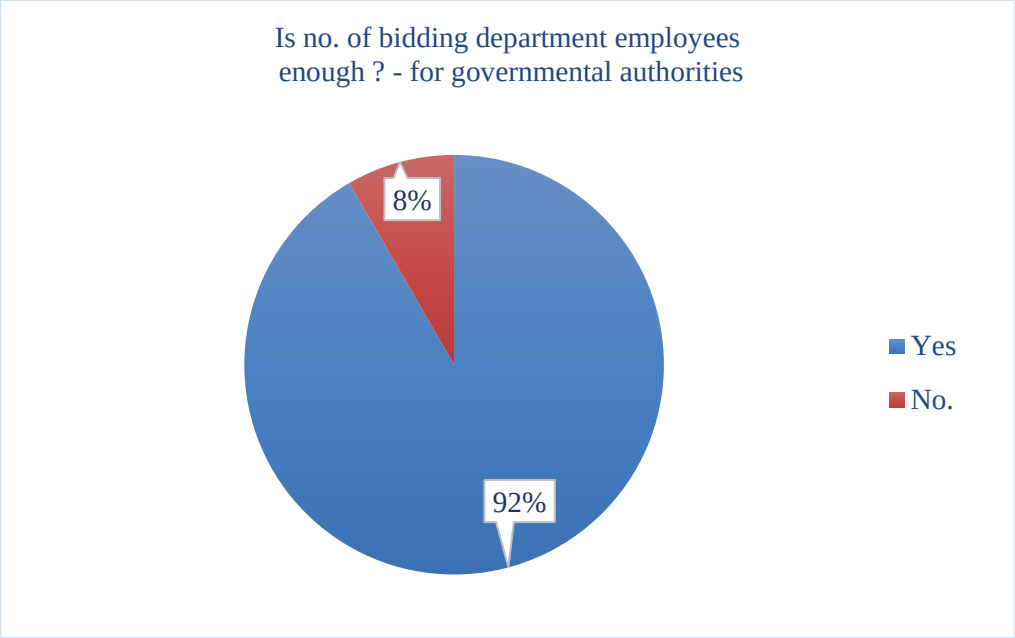

Figure 4.9: No. of bidding department employees (Enough or No) for the governmental authorities – percentage

The respondents – from governmental authorities' side – were asked if the number of bidding department employees their organization had was sufficient. Ninety-two percent of the respondents answered in the affirmative and only 8 % answered in the negative. The result is shown in Figure 4.9.

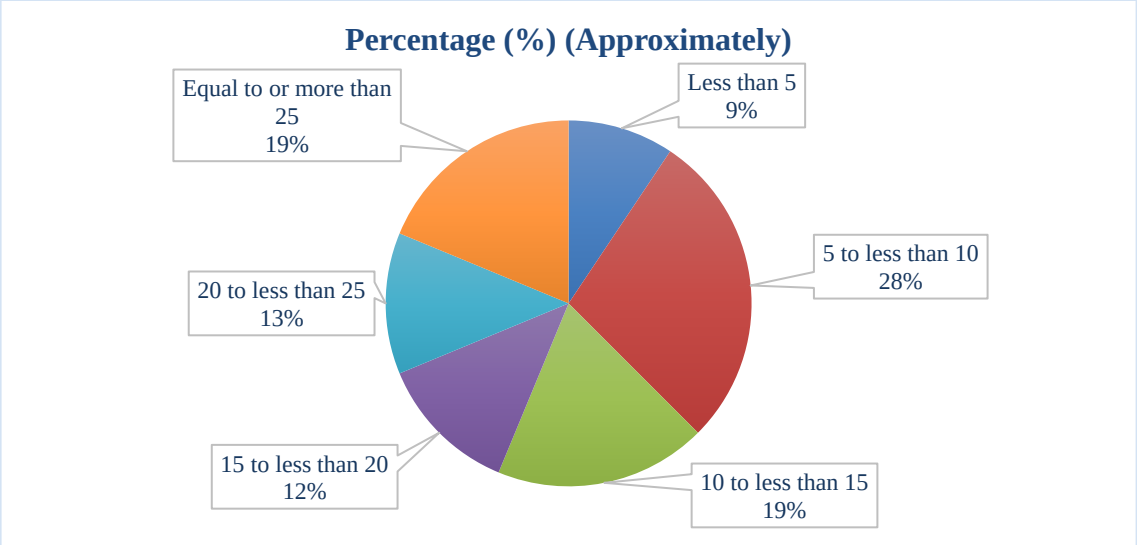

Figure 4.10: Combined respondents number of bidding department employees

From the figure 4.10, the most frequent bidding department's employee population falls under the "small" category, with 28 % of all the respondents. This collection of replies from organizations with diverse numbers of bidding department's employees helped in ascertaining that the results obtained from the survey were not biased to a certain category of organizations within the scope and limitation of this study. Also, it is clear from figures 4.6 and 4.9 that a large percentage of respondents admitted that they have a sufficient number of employees in their organizations' bidding department.

The average value of construction contracts under bidding (in millions of Saudi Riyals) by the respondents are categorized as below:

1. Extremely big: Equal to or more than 1000.
2. Very big: 700 to less than 1000.
3. Big: 500 to less than 700.
4. Moderate: 200 to less than 500.

5. Small: 50 to less than 200.
6. Very small: Less than 50.

The distribution of the average value of construction contracts under bidding (in millions Saudi Riyals) for the contracting organizations is given in Figure 4.11. “Very small” and “small”, the categories that accounts for the biggest share of the distribution, represents 25% of the contractor organization. “Very big”, is in second place with 20 % of contractors. Figure 4.12 shows the percentages of each category.

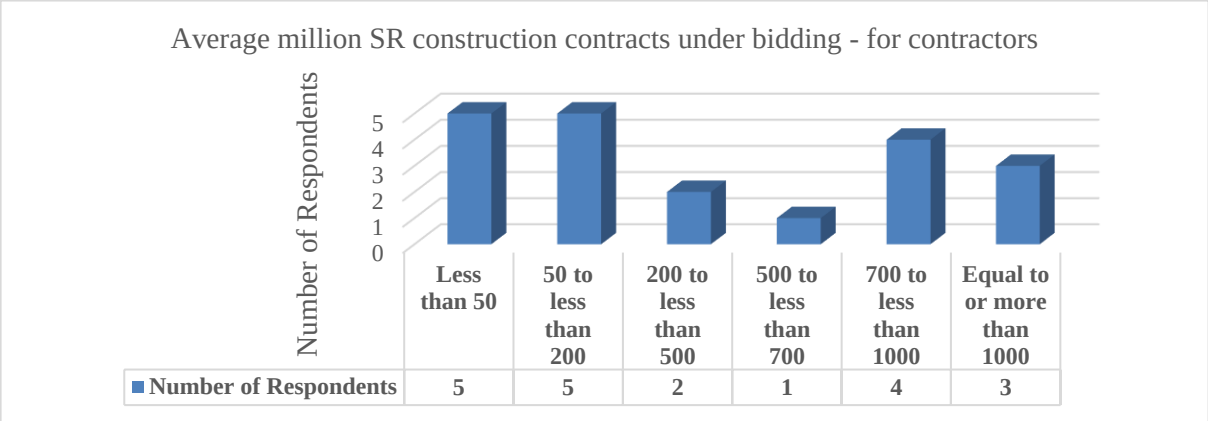

Figure 4.11: Average million SR construction contracts under bidding - for contractors

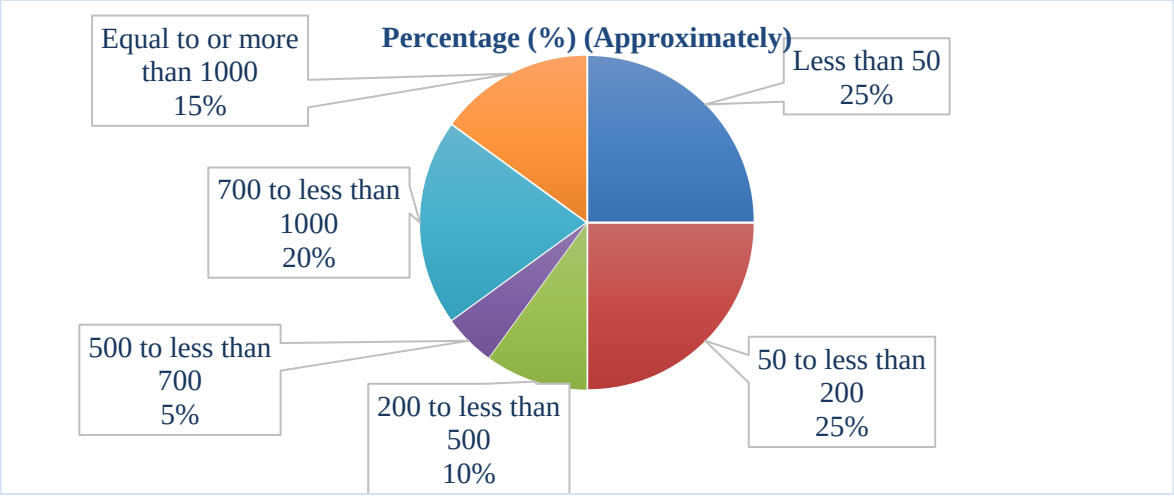

Figure 4.12: Average million SR construction contracts under bidding – percentage

The distribution of the average value of construction contracts under bidding (in millions Saudi Riyals) for the governmental authorities distribution is given in Figure 4.13. "Extremely big" the category that accounts for the biggest share of the distribution, represents 42% of the governmental authorities. "Small" is in second place with 25 % of the governmental authorities. Figure 4.14 shows the percentages of each category.

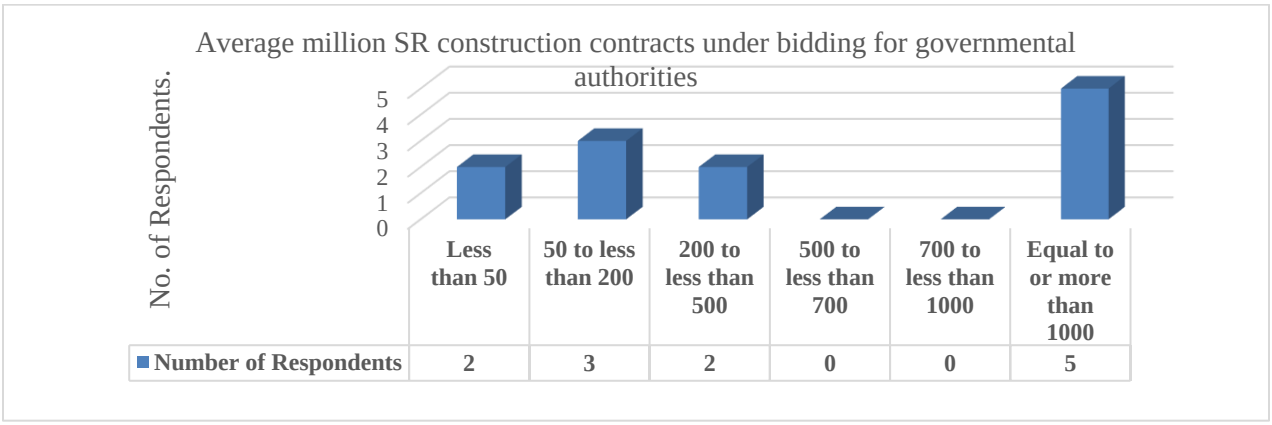

Figure 4.13: Average million SR construction contracts under bidding - for gov. authorities

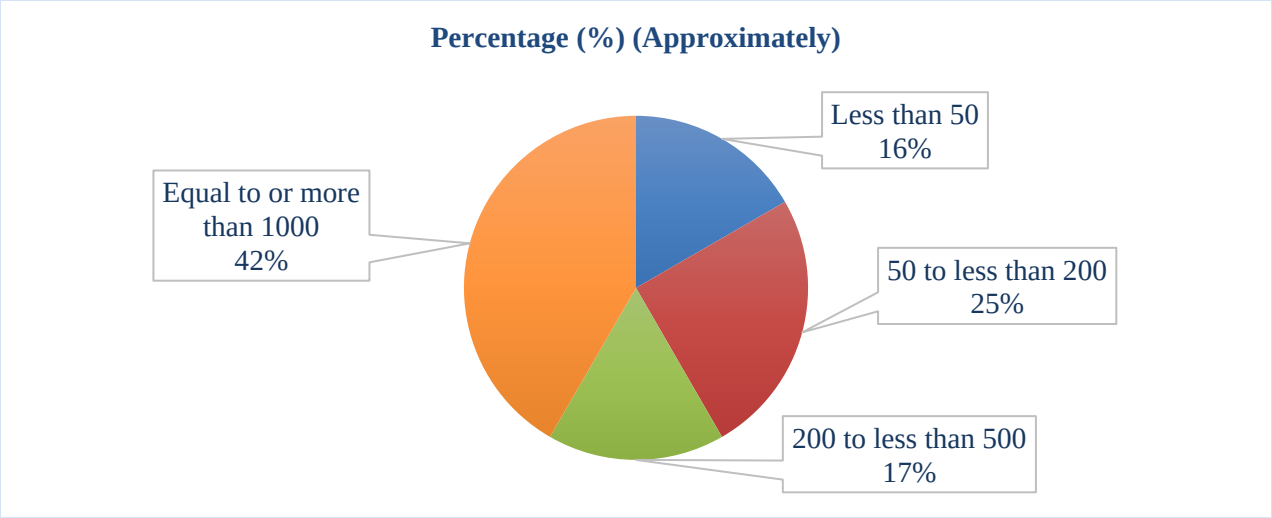

Figure 4.14: Average million SR construction contracts under bidding - for gov. authorities – Percentage

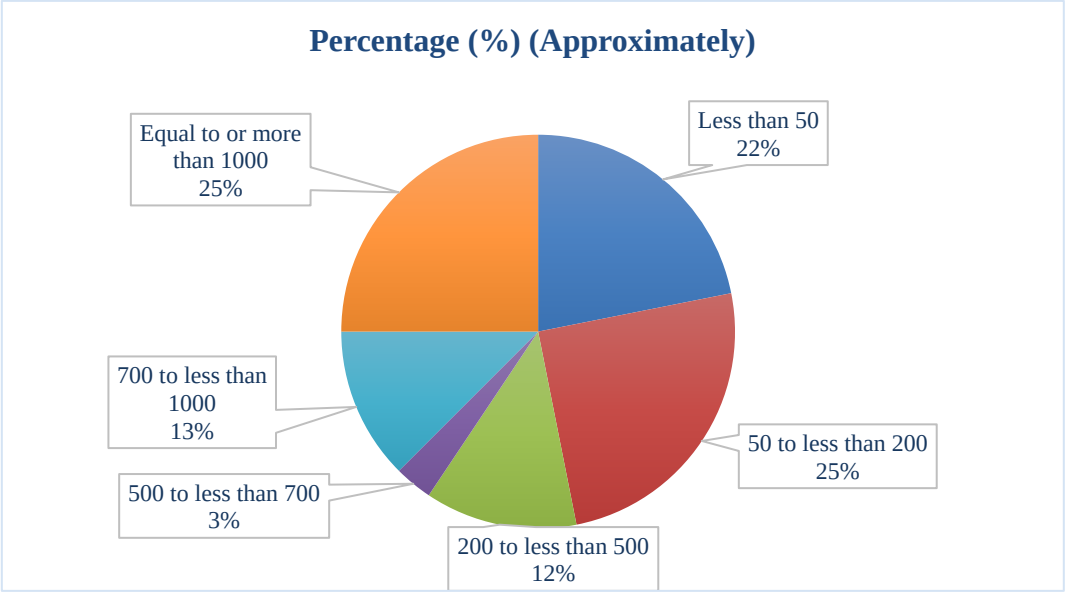

Figure 4.15: Combined respondents percentage of average million SR construction contracts under bidding

From figure 4.15, the most frequent number of average million SR construction contracts under bidding falls under the “small” and “extremely big” category, with 25 % of all respondents. Again, this collection of replies from organizations with diverse numbers of average million SR construction contracts under bidding helped in ascertaining that the results obtained from the survey were not biased to a certain category of project values.

The distribution of the types of projects executed by the contracting organizations is given in Figure 4.16. “Building”, the category that accounts for the biggest share of the distribution, with 20 respondents, representing 100% of the contractor organizations who participated in this survey. “Infrastructure” category came in second place with 8 respondents representing 40% of contracting organizations.

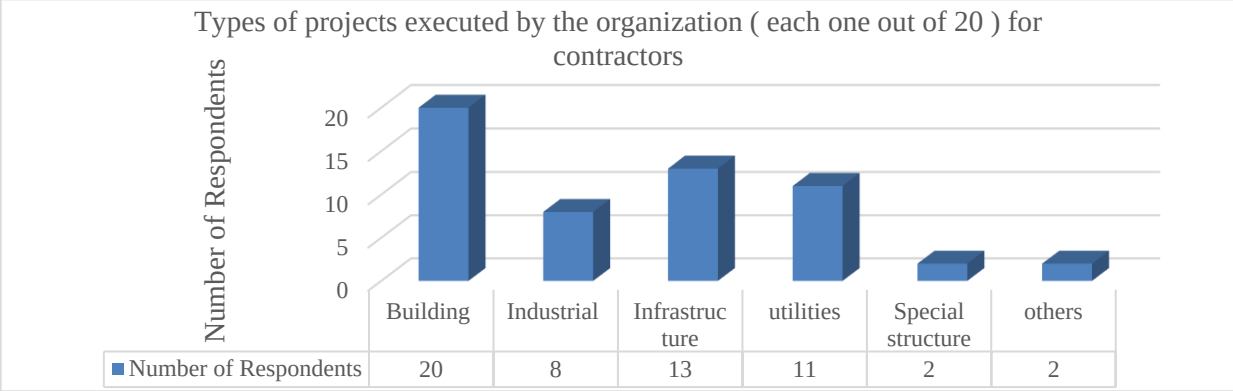

Figure 4.16: Types of projects executed by the organization (each one out of 20) for contractors

The distribution of the types of projects executed by the governmental authorities’ is given in Figure 4.17. “Infrastructure”, the category that accounts for the biggest share of the distribution with 11 respondents, represents 92% of the governmental authorities who

participated in this survey. “Building” category came in the second place with 10 respondents representing 83% of governmental authorities.

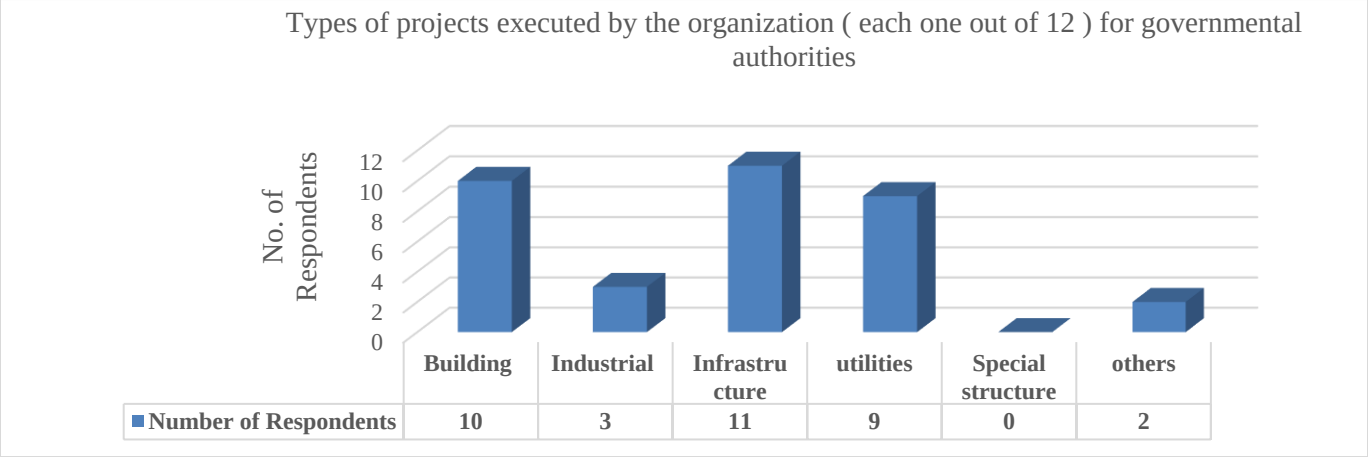

Figure 4.17: Types of projects executed by the organization (each one out of 12) - for governmental authorities

From figure 4.18, the most frequent type of project executed by the organizations in the study were buildings, with 94 % of all respondents falling under this category. This collection of replies from organizations with diverse types of projects helped in ascertaining that the results obtained from the survey were not biased to a certain type of project.

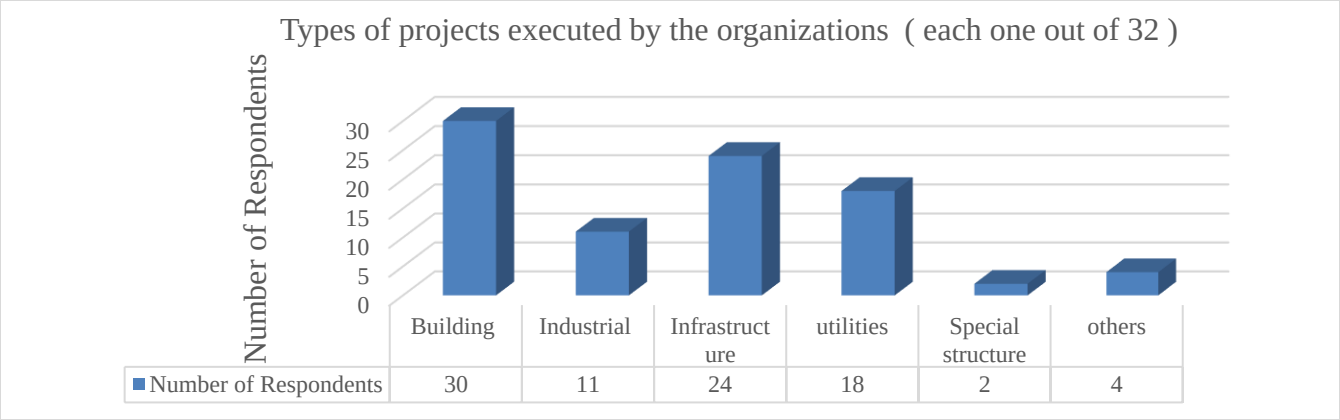

Figure 4.18: Types of projects executed by the organization (each one out of 32) – combined

The distribution of contractor organizations' classification according to ministry of municipalities and rural affairs is given in table 4.2. based on the scope and limitation of the study only 1st and 2nd class contractors in building construction participated. This collection of replies from organizations with diverse classification of projects helped in ascertaining that the results obtained from the survey were not biased to a certain grade of classification between 1st and 2nd grade building contractors.

.

Table 4.2: Classification of contractors according to ministry of municipalities and rural affairs (each one out of 20)

Rank, according to contractors classification agency (each one out of 20)	**Buildings construction**			
Rank	**1st**	**2nd**	**3rd**	**4th**
Number of Respondents	9	11	0	0
Percentage (%) (Approximately)	45%	55%	0%	0%

4.2.2 *General information regarding the respondents*

The distribution of the job titles of the respondents in the contracting organizations that participated in the study is given in Figure 4.19. “Head of bidding & estimation department”, which is the most frequent job title of the respondents, represents 20% of the contractor’s respondents. Figure 4.20 shows the percentages of each job title.

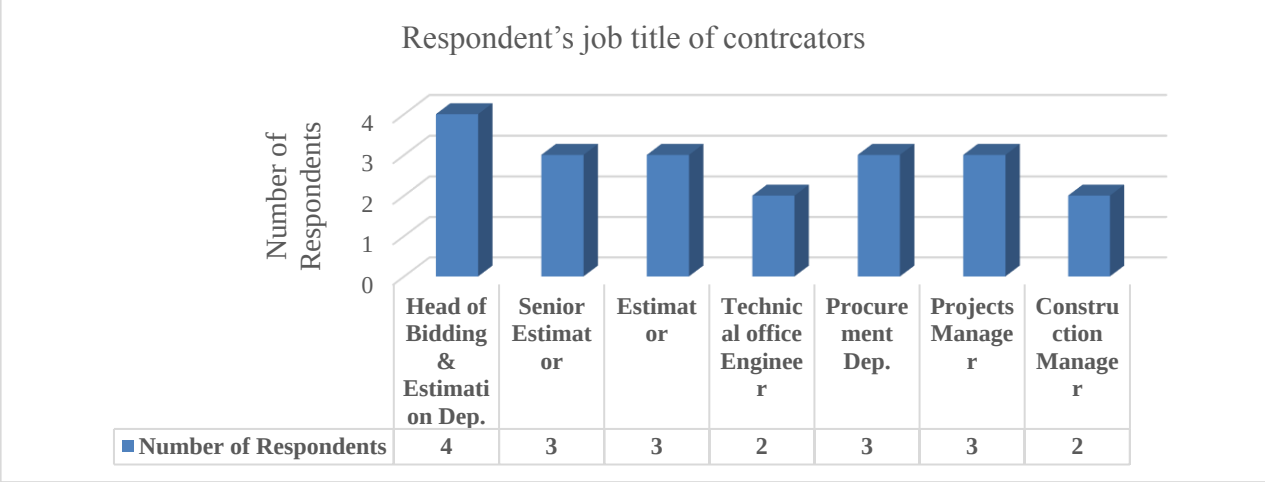

Figure 4.19: Respondent’s job title of contractors

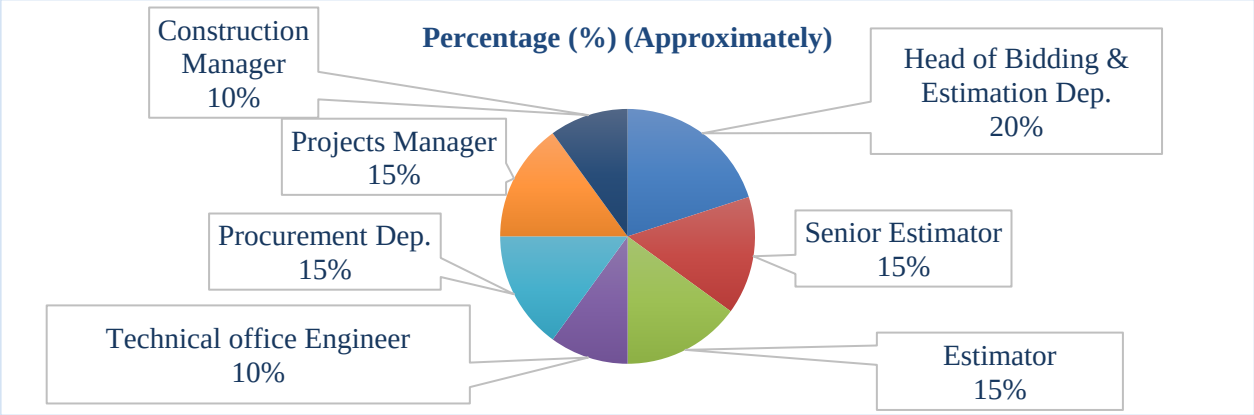

Figure 4.20: Respondent’s job title of contractors - Percentage

The distribution of the job titles of the respondents in the governmental authorities that participated in the study is given in Figure 4.21. “Project manager”, which is the most frequent job title of the respondents, represents 58 % of the governmental authorities’ respondents. Figure 4.22 shows the percentages of each job title.

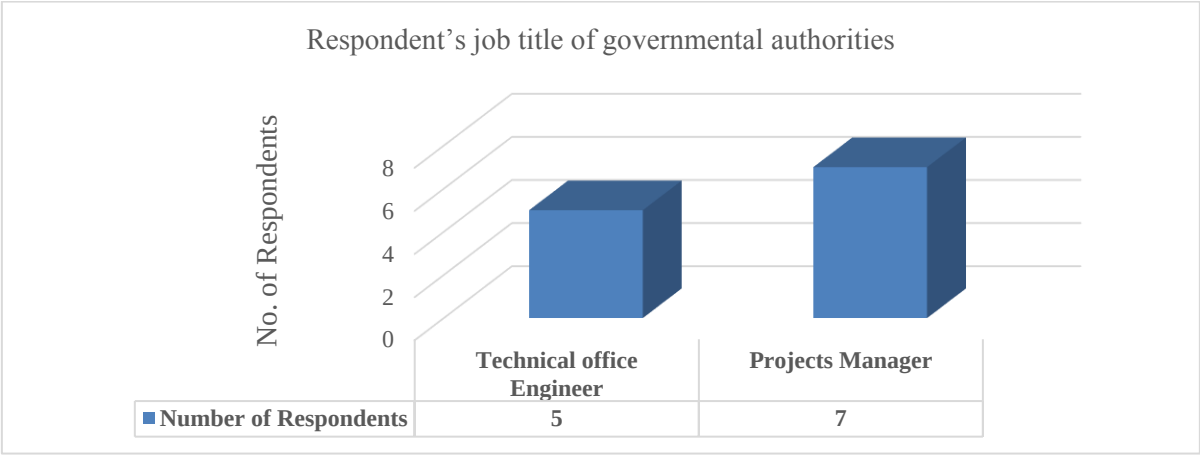

Figure 4.21: Respondent’s job title of governmental authorities

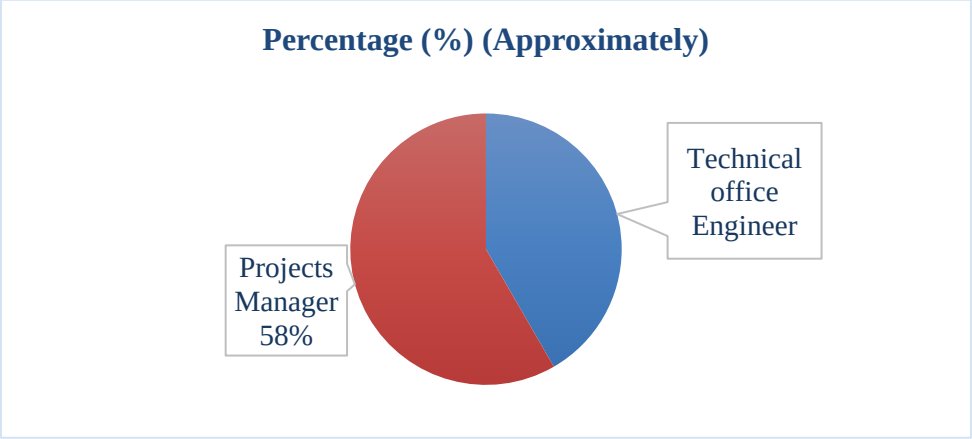

Figure 4.22: Respondent’s job title of governmental authorities – percentage

From figure 4.23, the most frequent job title is" Project manager", with 31 % of all respondents appearing in this category. This collection of replies from professionals with different backgrounds helped in ascertaining that results obtained from the survey were not biased towards a certain professional.

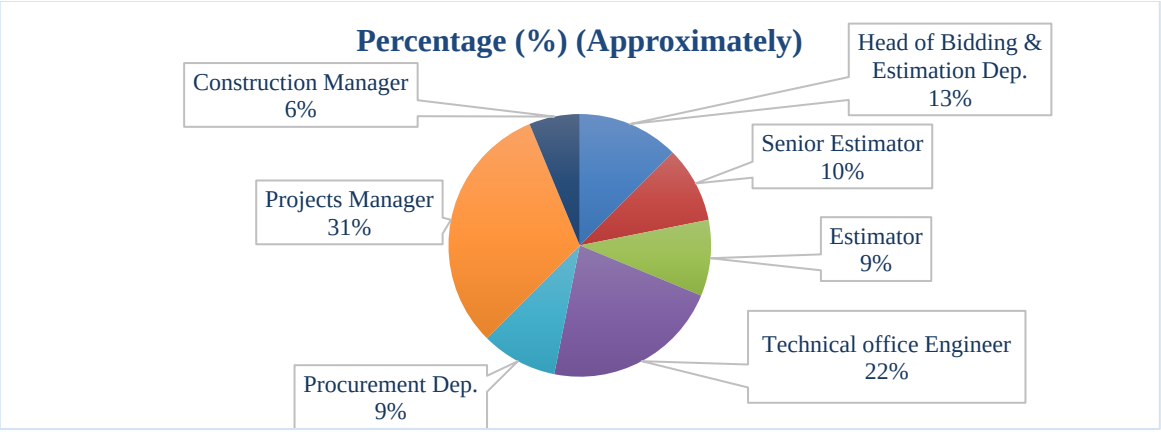

Figure 4.23: Respondent's job title of both parties combined – percentage

The educational level of the contractors is shown in Figure 4.24. The majority of the contractor's respondents had bachelor degree and only one had master's degree. Figure 4.25 shows the percentages of each educational level.

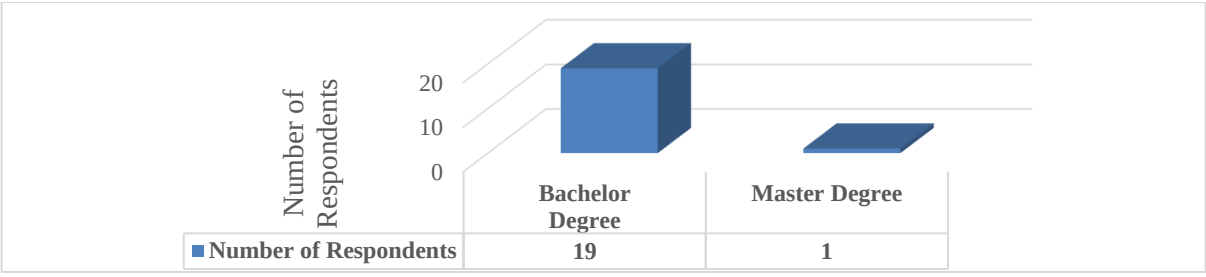

Figure 4.24: Respondents educational level of contactors

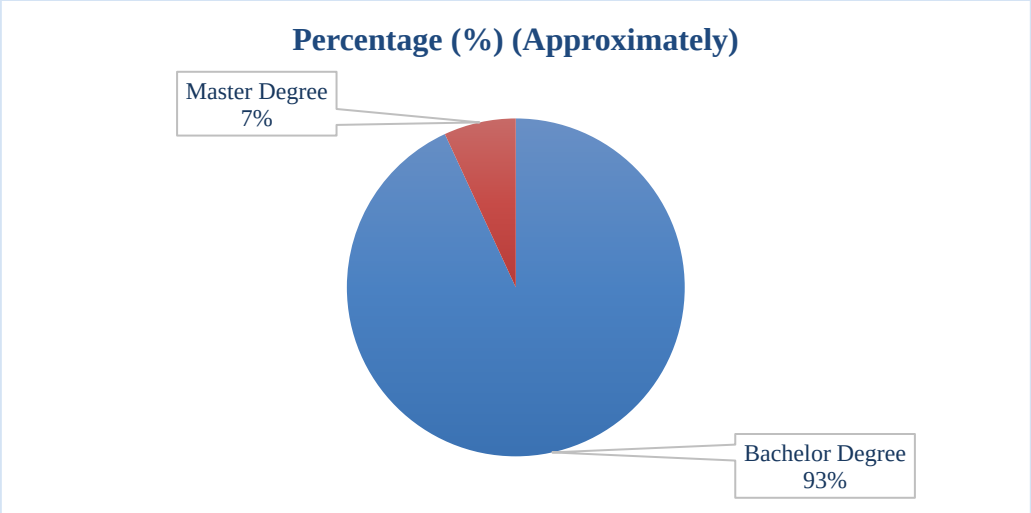

Figure 4.25: Respondents educational level of contactors – percentage

The educational level of the governmental authorities is shown in Figure 4.26. The majority of the governmental authorities' respondents had bachelor degrees and three respondents were holders of doctoral degrees. Figure 4.27 shows the percentages of each educational level.

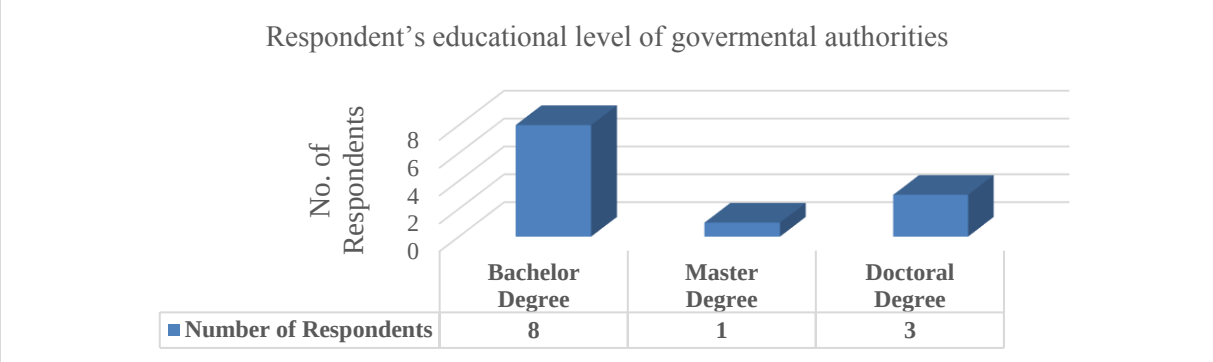

Figure 4.26: Respondent of governmental authorities' educational level

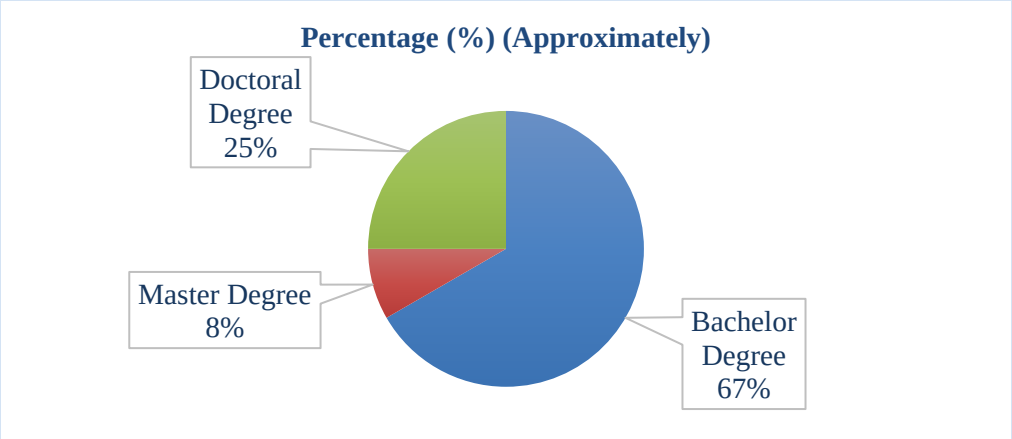

Figure 4.27: Respondent's educational level of governmental authorities– percentage

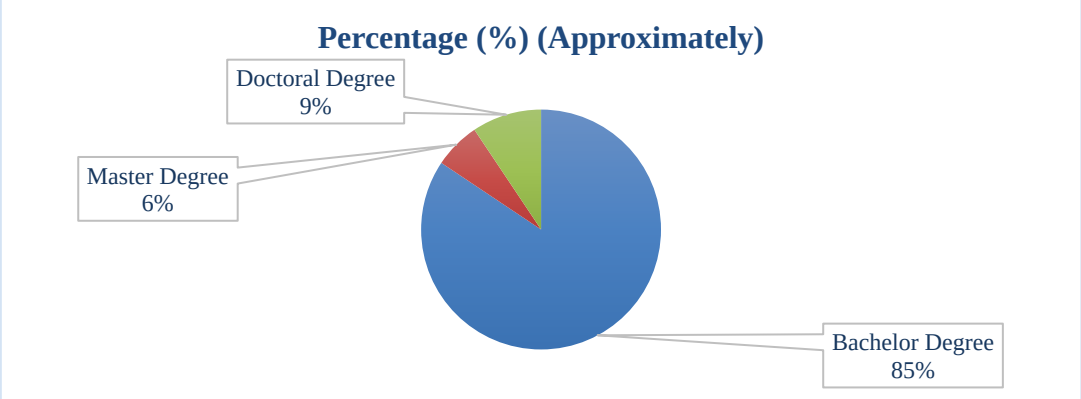

Figure 4.28: Respondent's educational level of both parties combined – percentage

Figure 4.28 shows the combined distribution of educational level of the survey's participants. It shows that more than half of the participants were holders of a bachelor degree. This was followed by holders of doctoral degrees. This educational distribution shows the high educational level of the participants. This quality of the study ensured that the answers to the technical questions were reliable.

The participants were asked whether they had any previous experience in the e-bidding field. Table 4.3, shows the answers of the contractors' respondents. More than half of these respondents agreed that they had previous experience in the e- bidding field.

Table 4.3: respondents of contractors' previous experience in e- bidding field

Do respondents have any previous experience in e- bidding field?	**Yes**	**No**
Number of Respondents	12	8
Percentage (%) (Approximately)	60%	40%

Table 4.4, shows the answers provided by the governmental authorities' respondents. Virtually all of these respondents indicated that they never had any previous experience in the e- bidding filed.

Table 4.4: respondents of governmental authorities' previous experience in e- bidding field

Do respondents have any previous experience in e- bidding field?	**Yes**	**No**
Number of Respondents	1	11
Percentage (%) (Approximately)	8 %	92 %

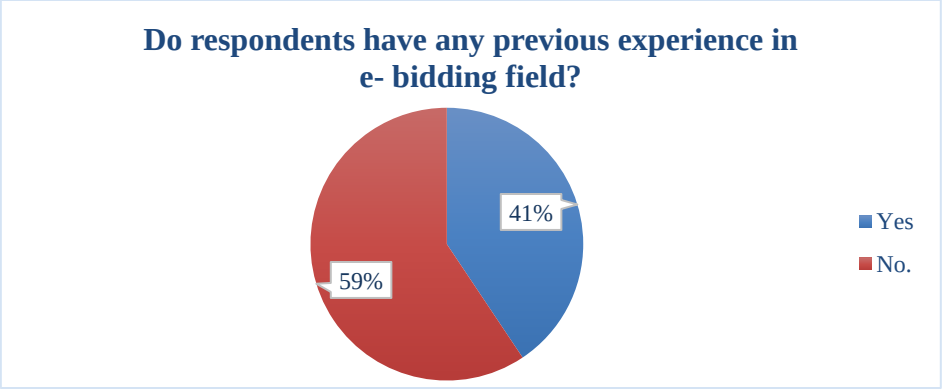

Figure 4.29: Respondents' previous experience in e- bidding field

Figure 4.29 shows the combined distribution of the participants who have previous experience in e-bidding. This figure shows that more than half of the participants did not have any previous experience in e-bidding. By contrast, only 41 % of the participants had previous experience in e-bidding.

The years of experience of the respondents are categorized as below:

1. Very long: 20 to less than 25 years.
2. Long: 15 to less than 20 years.
3. Moderate: 10 to less than 15 years.
4. Short: 5 to less than 10 years.
5. Very Short: less than 5 years.

The distribution of the contractor's years of experience is given in Figure 4.30. "Short", the category that accounts for the biggest share of the distribution, represents 40% of the contractors. The "Moderate" category comes in second place with 25% of the contractors falling under this category. Figure 4.31 shows the percentages of each category.

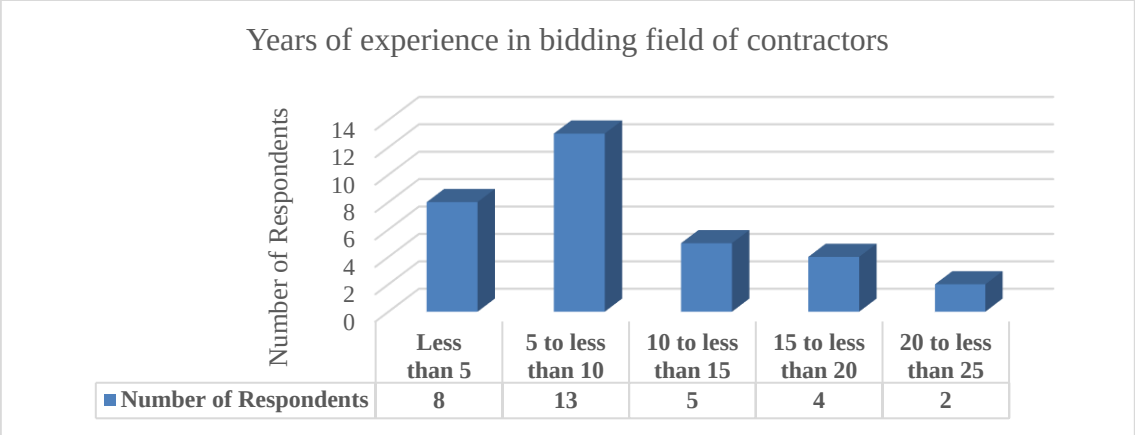

Figure 4.30: Years of experience in bidding field of contractors

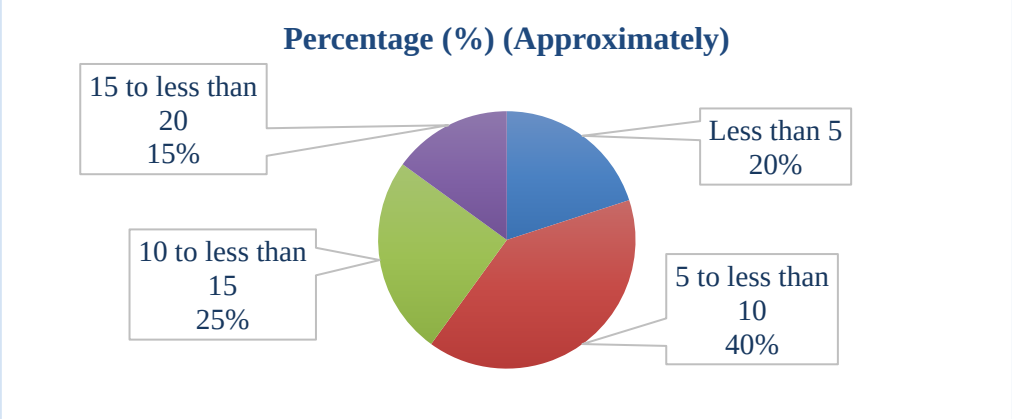

Figure 4.31: Years of experience in bidding field of contractors – Percentage

The distribution of the governmental authorities' years of experience is given in Figure 4.32. "Short", the category that accounts for the biggest share of the distribution, represents 42% of the contractors. The "Very short" category comes in second place with 33% of the

governmental authorities falling under this category. Figure 4.33 shows the percentages of each category.

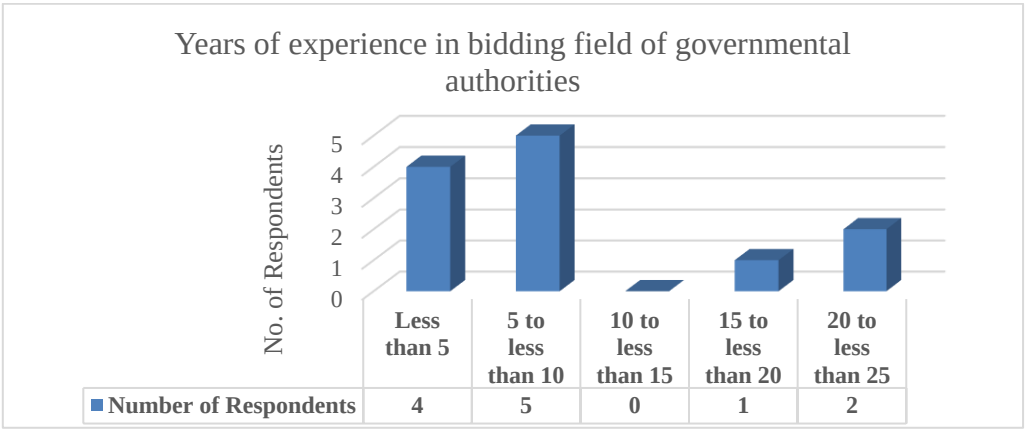

Figure 4.32: Years of experience in bidding field of governmental authorities

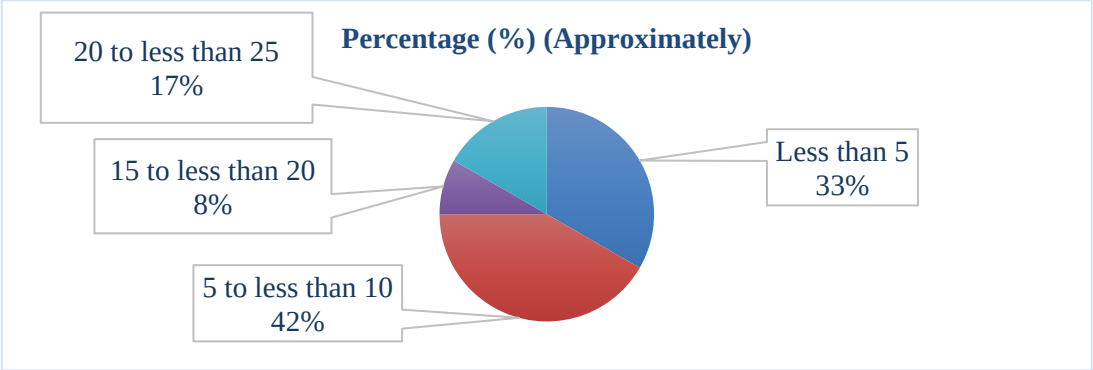

Figure 4.33: Years of experience in bidding field of governmental authorities

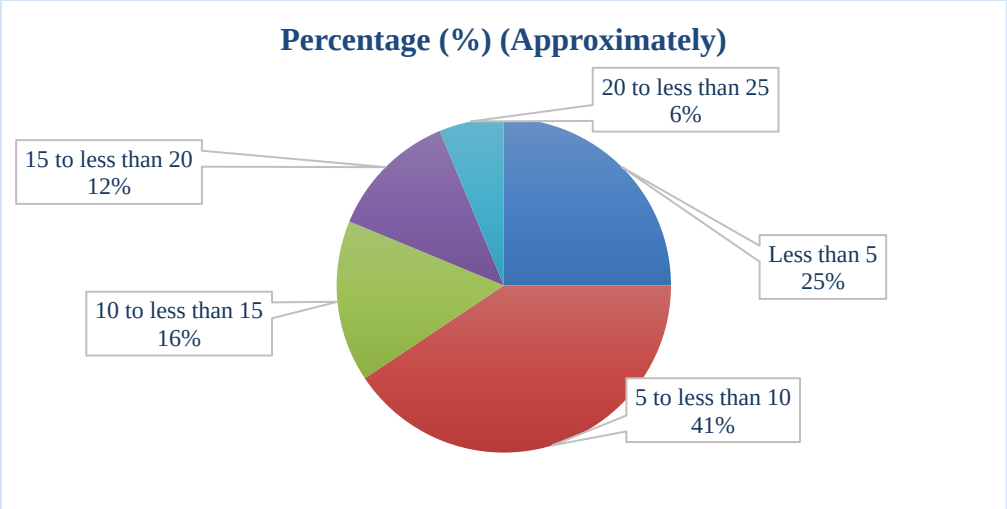

Figure 4.34: Years of experience in bidding field of respondents

The summery of all the respondents' experience is shown in Figure 4.34. The most common experience falls under the "short" category, representing 41 % of the total number of respondents. This collection of replies from participants with diverse levels of experiences helped in ascertaining that all results gained from the survey were not biased to the extent that participants with different experience might perceive the quantity of errors differently.

4.3 *Description of contractors' results*

Results obtained from the data analysis are displayed in this section in the form of tabular columns, charts, and percentiles.

4.3.1 **Driver factors results**

Table 4.5: Potential driving factors that may affect E-bidding adoption

No	Category	Drivers to e-bidding	Level of effect					Importance Index
			5	4	3	2	1	
1	Cost	Reducing Process Cost -(Bidding Process)	3	4	5	7	1	61.00
2	Cost	Reducing Transaction Administration Cost	11	4	5	0	0	86.00
3	Cost	Reducing Administration Costs in general	1	7	8	3	1	64.00
4	Cost	Increasing Profit Margins (For Contractors)	1	1	5	11	2	48.00
5	General	Enhancing documents Management and Archiving	12	5	2	0	1	87.00
6	Cost	Decreasing in expenses by reducing staffing levels	1	4	8	5	2	57.00
7	Time	Shortening Overall bidding process time consuming	1	2	12	3	2	57.00
8	Time	Shortening Communication process time consuming	6	9	3	1	1	78.00
9	Time	Reducing time by clearer transparency	2	7	6	3	2	64.00
10	Time	Reducing evaluation (bid assessment) time	1	4	12	3	0	63.00
11	Quality	Enhancing Quality by increasing competition	1	2	13	3	1	59.00
12	Quality	Enhancing Quality by increasing efficiency	1	5	11	2	1	63.00
13	Quality	Enhancing Quality by Improving Communication	2	13	3	1	1	74.00

In studying table 4.5, it can be seen that the most important factor is “Enhancing documents Management and Archiving” with an importance index of 87. The second most important factor is “Reducing Transaction Administration Cost” with an importance index of 86. The

third most important factor is “Shortening Communication process time consuming” with an importance index of 78. Finally, the fourth most important factor is “Enhancing Quality by Improving Communication” with an importance index of 74.

Table 4.6: Driver factors’ category that affect e-bidding adoption

Category	Importance Index
Cost	63.2
General	87
Time	65.5
Quality	65.33

With considering the broad categories, the Cost, Time and Quality categories receive nearly similar scores. The most important category is the general category with an average importance index of 87.

Only one factor comes under the general category, namely “Enhancing documents Management and Archiving” with an importance index of 87. The most important factor that comes under the time category is “Reducing Transaction Administration Cost” with an importance index of 86. The most important factor that comes under the quality category is “Enhancing Quality by Improving Communication” with an importance index of 74. Finally, the most important factor that comes under cost category is “Reducing Transaction Administration Cost” with an importance index of 86.

4.3.2 **Barrier factors results**

Table 4.7: Barrier factors that may affect e-bidding adoption

No	Category	Barriers to e-bidding	Level of effect					Importance index
			5	4	3	2	1	
1	Cultural	Staff resistance to change	4	4	7	4	1	66.00
2	Cultural	Lack of technical expertise (Skilled staff)	7	4	2	6	1	70.00
3	Cultural	Staff turnover	3	2	7	7	1	59.00
4	General	No development of confidence to use new technologies	2	6	8	2	2	64.00
5	Cultural	Bureaucratic dysfunctionalities	5	10	5	0	0	80.00
6	Infrastructure	No company access to internet	2	3	0	5	10	42.00
7	Legal	No legal position of e-bidding-availability of regulations	13	2	3	1	1	85.00
8	Infrastructure	Insufficient assessment of systems prior to installation	3	10	7	0	0	76.00
9	Security	Security in the process - Data transmission to the wrong person – Confidentiality of information	15	1	1	1	2	86.00
10	Security	Tampering with documents - changes to documents	13	2	4	0	1	86.00
11	Security	Data transmission reassembly – incorrect reassembly of data transmitted in packets	12	2	4	1	1	83.00
12	Security	Partial Data Display - incomplete documents provided	12	4	2	0	2	84.00
13	Legal	Lack of pertinent case law	11	4	2	3	0	83.00
14	Legal	Proof of intent - electronic signatures	8	7	3	1	1	80.00
15	Legal	Clarity of tenderee and tenderer information	1	1	9	8	1	53.00
16	Legal	Electronic bid evaluation	1	2	11	5	1	57.00
17	Cultural	Top or strategic management commitment for e-bidding	5	8	5	1	1	75.00

No	Category	Barriers to e-bidding	Level of effect					Importance index
			5	4	3	2	1	
18	Cultural	Organizational magnitude of changing management	2	9	6	3	0	70.00
19	Cultural	Lack of national IT policy relating to e-bidding Issues	5	8	2	3	2	71.00
20	Cultural	Lack of flexibility of organization's law and system	3	6	4	6	1	64.00
21	Cultural	Complicated procedures.	11	3	3	2	1	81.00
22	Cost	Cost of information technology investment	0	1	3	14	2	43.00
23	Cost	E-bidding implementation cost (include system licences)	1	1	4	13	1	48.00
24	General	No business benefit realised	4	10	3	3	0	75.00
25	Compatibility	Investment in compatible systems	2	2	5	9	2	53.00
26	Infrastructure	Slow and bad internet service by service providers	3	9	4	1	3	68.00
27	Cost	Cost of internet service	0	1	2	14	3	41.00

In studying table 4.7, it can be seen that the most important factors are "Security in the process - Data transmission to the wrong person – Confidentiality of information" and "Tampering with documents - changes to documents" with importance indices of 86 apiece. The second most important factor is "No legal position of e-bidding- availability of regulations" with an importance index of 85. The third most important factor is "Partial Data Display - incomplete documents provided" with an importance index of 84.

Table 4.8: Barrier factors' category that may affect e-bidding adoption

Category	Importance Index
General	69.50
Infrastructure	62.00
Legal	71.60
Security	84.75
Cost	44.00
Cultural	70.67
Compatibility	53.00

With considering the broad categories, the Security category receives the highest score with an average importance index of 84.75. The second highest is the Legal category with an average importance index of 71.60.

The most important factors comes under the security category are "Security in the process - Data transmission to the wrong person – Confidentiality of information" and "Tampering with documents - changes to documents" with importance indices of 86 each. The most important factor that comes under the legal category is "No legal position of e-bidding-availability of regulations" with an importance index of 85. For the cultural category, "Complicated procedures" is the most important factor that comes under this category. The most important factor that comes under the general category is "No business benefit realised" with an importance index of 75. The most important factor that comes under the

infrastructure category is “Insufficient assessment of systems prior to installation” with an importance index of 76. One factor comes under the compatibility category, namely “Investment in compatible systems” with an importance index of 53. The most important factor that comes under the cost category is “E-bidding implementation cost (include system licences)” is the most important factor comes under this category with an importance index of 48.

4.3.3 **Organization**’s **readiness for e-bidding results**

Table 4.9: Organization readiness for e-bidding results

No	Readiness for E- bidding	Level of Readiness					Importance Index
		5	4	3	2	1	
1	Organization Staff (knowledge)	1	9	6	2	2	65.00
2	Organization Staff (Resistance to change)	2	6	7	4	1	64.00
3	Organization higher management	2	12	5	1	0	75.00
4	The available IT infrastructure in the organization	5	7	4	3	1	72.00
5	Financial Sources to fund the system	8	5	5	1	1	78.00

In studying table 4.9, it can be seen that the most ready element in the contractor’s organizations is “Financial Sources to fund the e-bidding system” with an importance index of 78. The second most ready element in contractor’s organizations is “Organization higher management” with an importance index of 75. The third most ready element in the contractor’s organizations is “The available IT infrastructure in the organization” with an importance index of 72.

4.3.4 **Overall readiness for e-bidding results**

Table 4.10: Overall readiness for e-bidding results

No	Readiness for E- bidding	Level of Readiness					Importance Index
		5	4	3	2	1	
1	Governmental Authorities	0	8	7	4	1	62.00
2	Construction Contractors	2	9	5	4	0	69.00
3	Governmental laws	2	1	4	8	5	47.00
4	Internet Service Providers	2	10	6	2	0	72.00

In studying table 4.10, it can be seen that the most ready element in the construction industry is “Internet Service Providers” with an importance index of 72. The second most ready element in the construction industry is “Construction Contractors” with an importance index of 69. The third most ready element in the construction industry is “Governmental Authorities” with an importance index of 62. The least ready element in the construction industry is “Governmental laws” with an importance index of 47.

4.4 *Description of governmental authorities' results*

Results obtained from the data analysis are displayed in this section in the form of tabular columns, charts, and percentiles.

4.4.1 **Driver factors results**

Table 4.11: Potential driving factors that may affect e-bidding adoption

No	Category	Drivers to e-bidding	Level of effect					Importance Index
			5	4	3	2	1	
1	Cost	Reducing Process Cost - (Bidding Process)	3	3	2	3	1	66.67
2	Cost	Reducing Transaction Administration Cost	4	3	3	2	0	75.00
3	Cost	Reducing Administration Costs in general	2	3	5	2	0	68.33
4	Cost	Increasing Profit Margins (For Contractors)	0	3	3	4	2	51.67
5	General	Enhancing documents Management and Archiving	10	1	1	0	0	95.00
6	Cost	Decreasing in expenses by reducing staffing levels	1	3	4	4	0	61.67
7	Time	Shortening Overall bidding process time consuming	2	3	6	1	0	70.00
8	Time	Shortening Communication process time consuming	2	6	3	1	0	75.00
9	Time	Reducing time by clearer transparency	4	4	4	0	0	80.00
10	Time	Reducing evaluation (bid assessment) time	3	2	3	4	0	66.67
11	Quality	Enhancing Quality by increasing competition	0	2	8	1	1	58.33
12	Quality	Enhancing Quality by increasing efficiency	1	3	6	1	1	63.33
13	Quality	Enhancing Quality by Improving Communication	2	7	1	2	0	75.00

In studying table 4.11, it can be seen that the most important factor is “Enhancing documents Management and Archiving” with an importance index of 95. The second most important factor is “Reducing time by clearer transparency” with an importance index of 80. The third most important set of factors are “Reducing Transaction Administration Cost”, “Shortening Communication process time consuming” and “Enhancing Quality by Improving Communication” with importance indices of 75 each.

The fourth most important factor is “Shortening Overall bidding process time consuming” with an importance index of 70.

Table 4.12: Driver factors’ category that may affect e-bidding adoption

Category	**Importance Index**
Cost	64.67
General	95.00
Time	72.92
Quality	65.56

With considering the broad categories, the the general category receives the highest importance index with an average of 95. The second most important category is the Time category with an average importance index of 72.92. The importance index of the Cost and Quality categories are almost the same.

Only one factor comes under the general category which is “Enhancing documents Management and Archiving” with an importance index of 95. The most important factor that comes under the time category is “Reducing time by clearer transparency” with an importance index of 80. The most important factor that comes under the quality category is “Enhancing Quality by Improving Communication” with an importance index of 75. Finally, the most important factor that comes under the cost category is “Reducing Transaction Administration Cost” with an importance index of 75.

4.4.2 **Barrier factors results**

Table 4.13: Barrier factors that may affect e-bidding adoption

No	Category	Barriers to e-bidding	Level of effect					Importance Index
			5	4	3	2	1	
1	Cultural	Staff resistance to change	2	4	5	1	0	71.67
2	Cultural	Lack of technical expertise (Skilled staff)	3	4	2	2	1	70.00
3	Cultural	Staff turnover	0	3	4	4	1	55.00
4	General	No development of confidence to use new technologies	0	4	5	3	0	61.67
5	Cultural	Bureaucratic dysfunctionalities	1	5	4	2	0	68.33
6	Infrastructure	No company access to internet	2	3	0	3	4	53.33
7	Legal	No legal position of e-bidding- availability of regulations	4	4	2	2	0	76.67
8	Infrastructure	Insufficient assessment of systems prior to installation	1	6	3	2	0	70.00
9	Security	Security in the process - Data transmission to the wrong person – Confidentiality of information	6	2	3	1	0	81.67
10	Security	Tampering with documents - changes to documents	5	3	0	2	2	71.67
11	Security	Data transmission reassembly – incorrect reassembly of data transmitted in packets	2	7	3	0	0	78.33
12	Security	Partial Data Display - incomplete documents provided	4	5	3	0	0	81.67
13	Legal	Lack of pertinent case law	4	4	3	1	0	78.33
14	Legal	Proof of intent - electronic signatures	5	4	2	1	0	81.67
15	Legal	Clarity of tenderee and tenderer information	1	5	3	3	0	66.67
16	Legal	Electronic bid evaluation	0	4	4	4	0	60.00

No	Category	Barriers to e-bidding	Level of effect					Importance Index
			5	4	3	2	1	
17	Cultural	Top or strategic management commitment for e-bidding	5	3	3	1	0	80.00
18	Cultural	Organizational magnitude of changing management	6	3	2	1	0	83.33
19	Cultural	Lack of national IT policy relating to e-bidding Issues	5	3	2	1	1	76.67
20	Cultural	Lack of flexibility of organization's law and system	2	3	3	4	0	65.00
21	Cultural	Complicated procedures.	3	4	4	1	0	75.00
22	Cost	Cost of information technology investment	1	1	4	4	2	51.67
23	Cost	E-bidding implementation cost (include system licences)	3	2	3	2	2	63.33
24	General	No business benefit realised	4	2	5	0	1	73.33
25	Compatibility	Investment in compatible systems	2	2	2	3	3	55.00
26	Infrastructure	Slow and bad internet service by service providers	3	3	4	1	1	70.00
27	Cost	Cost of internet service	1	0	2	4	5	40.00

In studying table 4.13, it can be seen that the most important factor is "Organizational magnitude of changing management" with an important index of 83.33. The second most important factors are "Security in the process - Data transmission to the wrong person – Confidentiality of information", "Partial Data Display - incomplete documents provided" and "Proof of intent - electronic signatures" with importance indices of 81.67 each. The third most important factor is "Top or strategic management commitment for e-bidding" with an importance index of 80. The fourth most important factors are "Data transmission

reassembly – incorrect reassembly of data transmitted in packets" and "Lack of pertinent case law" with importance indices of 78.33 each.

Table 4.14: Barrier's category that may affect e-bidding adoption

Category	Importance Index
General	67.50
Infrastructure	64.44
Legal	72.67
Security	78.33
Cost	51.67
Cultural	71.67
Compatibility	55.00

With considering the broad categories, the Security category receives the highest importance index with an average of 78.33. The second most important category is the Legal category with an average importance index of 72.67. The third most important category is the Cultural category with an average importance index of 71.67.

The most important factors that come under the security category are "Security in the process - Data transmission to the wrong person – Confidentiality of information", "Partial Data Display - incomplete documents provided" with importance indices of 81.67 each.

The most important factor that comes under the legal category is "Proof of intent -

electronic signatures" with an importance index of 81.67. For the cultural category, the "Organizational magnitude of changing management" is the most important factor that comes under this category with an importance index of 83.33. The most important factor that comes under the general category is "No business benefit realised" with an importance index of 73.33. The set of the most important factors that come under the infrastructure category are "Insufficient assessment of systems prior to installation" and the "Slow and bad internet service by service providers" with importance indices of 70 each. "Investment in compatible systems" is the only factor that comes under the compatibility category with an importance index of 55. The most important factor that comes under cost category is "E-bidding implementation cost (include system licences)" with an importance index of 63.33.

4.4.3 **Organization readiness for e-bidding results**

Table 4.15: Organization readiness for e-bidding results

No	Readiness for E- bidding	Level of Readiness					Importance Index
		5	4	3	2	1	
1	Organization Staff (knowledge)	2	2	4	4	0	63.33
2	Organization Staff (Resistance to change)	3	4	4	1	0	75.00
3	Organization higher management	7	2	2	1	0	85.00
4	The available IT infrastructure in the organization	4	1	2	4	1	65.00
5	Financial Sources to fund the system	6	0	5	1	0	78.33

In studying table 4.15, it can be seen that the most ready element in the governmental authorities is “Organization higher management” with an importance index of 85. The second most ready element is “Financial Sources to fund the system” with an importance index of 78.33. The third most ready element is “Organization Staff (Resistance to change)” with an importance index of 75.

4.4.4 **Overall readiness for e-bidding results**

Table 4.16: Overall readiness for e-bidding results

No	Readiness for E- bidding	Level of Readiness					Importance Index
		5	4	3	2	1	
1	Governmental Authorities	5	3	1	3	0	76.67
2	Construction Contractors	5	3	3	1	0	80.00
3	Governmental laws	0	4	5	2	1	60.00
4	Internet Service Providers	4	3	4	1	0	76.67

In studying table 4.16, it can be seen that the most ready element in the construction industry is “Construction Contractors” with an importance index of 80. The second most ready elements in the construction industry are “Governmental Authorities” and “Internet Service Providers” with importance indices of 76.67 each. The least ready element in the construction industry is “Governmental laws” with an importance index of 60.

4.5 *Factor significance*

The importance indices in the following tables range from the lowest, 40, to the highest, 95. Based on this range, in order to identify the most significant factors, the scale is made in between 40 and 95. The following figure graphically summarizes the 5 range categories.

Table 4.17: Ranking and importance index categorization

Importance	**The Classification**
40 – 50	Low significant
51 – 60	Medium low significant
61 – 70	Medium significant
71 – 80	Medium high significant
81 – 95	High significant

4.5.1 For Driver factors

4.5.1.1 Contractors

Table 4.18: Ranking and classification of driver factors – for contractors

Ranking	Factor No	Category	Drivers to e-bidding	Importance Index	Classification
1	5	General	Enhancing documents Management and Archiving	87.00	High significant
2	2	Cost	Reducing Transaction Administration Cost	86.00	
3	8	Time	Shortening Communication process time consuming	78.00	Medium high significant
4	13	Quality	Enhancing Quality by Improving Communication	74.00	
5	3	Cost	Reducing Administration Costs in general	64.00	Medium significant
6	9	Time	Reducing time by clearer transparency	64.00	
7	10	Time	Reducing evaluation (bid assessment) time	63.00	
8	12	Quality	Enhancing Quality by increasing efficiency	63.00	
9	1	Cost	Reducing Process Cost -(Bidding Process)	61.00	
10	11	Quality	Enhancing Quality by increasing competition	59.00	Medium low significant
11	6	Cost	Decreasing in expenses by reducing staffing levels	57.00	
12	7	Time	Shortening Overall bidding process time consuming	57.00	
13	4	Cost	Increasing Profit Margins (For Contractors)	48.00	Low significant

Based on Table 4.18, factors ranking shows that:

2 factors are “High significant”

2 factors are “Medium high significant”

5 factors are “Medium significant”

3 factors are “Medium low significant”

1 factor is “Low significant”

The high significant factors are:

1- Enhancing documents Management and Archiving.

2- Reducing Transaction Administration Cost.

The medium high significant factors are:

1- Shortening Communication process time consuming.

2- Enhancing Quality by Improving Communication.

The medium significant factors are:

1- Reducing Administration Costs in general.

2- Reducing time by clearer transparency.

3- Reducing evaluation (bid assessment) time.

4- Enhancing Quality by increasing efficiency.

5- Reducing Process Cost - (Bidding Process).

The medium low significant factors are:

1- Enhancing Quality by increasing competition.

2- Decreasing in expenses by reducing staffing levels.

3- Shortening Overall bidding process time consuming.

The low significant factors are:

1- Increasing Profit Margins (For Contractors).

4.5.1.2 Governmental authorities

Table 4.19: Ranking and classification of driver factors – for governmental authorities

Ranking	Factor No	Category	Drivers to e-bidding	Importance Index	Classification
1	5	General	Enhancing documents Management and Archiving	95.00	High significant
2	9	Time	Reducing time by clearer transparency	80.00	Medium high significant
3	2	Cost	Reducing Transaction Administration Cost	75.00	
4	8	Time	Shortening Communication process time consuming	75.00	
5	13	Quality	Enhancing Quality by Improving Communication	75.00	
6	7	Time	Shortening Overall bidding process time consuming	70.00	Medium significant
7	3	Cost	Reducing Administration Costs in general	68.33	
8	1	Cost	Reducing Process Cost -(Bidding Process)	66.67	
9	10	Time	Reducing evaluation (bid assessment) time	66.67	
10	12	Quality	Enhancing Quality by increasing efficiency	63.33	
11	6	cost	Decreasing in expenses by reducing staffing levels	61.67	
12	11	Quality	Enhancing Quality by increasing competition	58.33	Medium low significant
13	4	Cost	Increasing Profit Margins (For Contractors)	51.67	

Based on Table 4.19, factors ranking shows that:

1 factor is “High significant”

4 factors are “Medium high significant”

6 factors are “Medium significant”

2 factors are “Medium low significant”

0 factor is “Low significant”

The high significant factors is:

1- Enhancing documents Management and Archiving.

The medium high significant factors are:

1- Reducing time by clearer transparency.

2- Reducing Transaction Administration Cost.

3- Shortening Communication process time consuming.

4- Enhancing Quality by Improving Communication.

The medium significant factors are:

1- Shortening Overall bidding process time consuming.

2- Reducing Administration Costs in general.

3- Reducing Process Cost - (Bidding Process).

4- Reducing evaluation (bid assessment) time.

5- Enhancing Quality by increasing efficiency.

6- Decreasing in expenses by reducing staffing levels.

The medium low significant factors are:

1- Enhancing Quality by increasing competition.

2- Increasing Profit Margins (For Contractors).

4.5.2 For Barrier factors

4.5.2.1 Contractors

Table 4.20: Ranking and classification of barrier factors – for Contractors

Ranking	Factor No	Category	Barriers to e-bidding	Importance index	Classification
1	9	Security	Security in the process - Data transmission to the wrong person – Confidentiality of information	86.00	High significant
2	10	Security	Tampering with documents - changes to documents	86.00	
3	7	Legal	No legal position of e-bidding- availability of regulations	85.00	
4	12	Security	Partial Data Display - incomplete documents provided	84.00	
5	11	Security	Data transmission reassembly - incorrect reassembly of data transmitted in packets	83.00	
6	13	Legal	Lack of pertinent case law	83.00	
7	21	Cultural	Complicated procedures.	81.00	
8	5	Cultural	Bureaucratic dysfunctionalities	80.00	Medium high significant
9	14	Legal	Proof of intent - electronic signatures	80.00	
10	8	Infrastructure	Insufficient assessment of systems prior to installation	76.00	
11	17	Cultural	Top or strategic management commitment for e-bidding	75.00	
12	24	General	No business benefit realised	75.00	
13	19	Cultural	Lack of national IT policy relating to e-bidding Issues	71.00	

Ranking	Factor No	Category	Barriers to e-bidding	Importance index	Classification
14	2	Cultural	Lack of technical expertise (Skilled staff)	70.00	Medium significant
15	18	Cultural	Organizational magnitude of changing management	70.00	
16	26	Infrastructure	Slow and bad internet service by service providers	68.00	
17	1	Cultural	Staff resistance to change	66.00	
18	4	General	No development of confidence to use new technologies	64.00	
19	20	Cultural	Lack of flexibility of organization's law and system	64.00	
20	3	Cultural	Staff turnover	59.00	Medium low significant
21	16	Legal	Electronic bid evaluation	57.00	
22	15	Legal	Clarity of tenderee and tenderer information	53.00	
23	25	Compatibility	Investment in compatible systems	53.00	
24	23	Cost	E-bidding implementation cost (include system licences)	48.00	Low significant
25	22	Cost	Cost of information technology investment	43.00	
26	6	Infrastructure	No company access to internet	42.00	
27	27	Cost	Cost of internet service	41.00	

Based on Table 4.20, Contractors rank shows that:

7 factors are "High significant"

6 factors are "Medium high significant"

6 factors are "Medium significant"

4 factors are “Medium low significant”

4 factors are “Low significant”

The high significant factors are:

1- Security in the process - Data transmission to the wrong person – Confidentiality of information.
2- Tampering with documents - changes to documents.
3- No legal position of e-bidding- availability of regulations.
4- Partial Data Display - incomplete documents provided.
5- Data transmission reassembly – incorrect reassembly of data transmitted in packets.
6- Lack of pertinent case law.
7- Complicated procedures.

The medium high significant factors are:

1- Bureaucratic dysfunctionalities.
2- Proof of intent - electronic signatures.
3- Insufficient assessment of systems prior to installation.
4- Top or strategic management commitment for e-bidding.
5- No business benefit realised.
6- Lack of national IT policy relating to e-bidding Issues.

The medium significant factors are:

1- Lack of technical expertise (Skilled staff).
2- Organizational magnitude of changing management.
3- Slow and bad internet service by service providers,
4- Staff resistance to change.

5- No development of confidence to use new technologies.

6- Lack of flexibility of organization's law and system.

The medium low significant factors are:

1- Staff turnover.

2- Electronic bid evaluation.

3- Clarity of tenderee and tenderer information.

4- Investment in compatible systems.

The medium low significant factors are:

1- E-bidding implementation cost (include system licences).

2- Cost of information technology investment.

3- No company access to internet.

4- Cost of internet service.

4.5.2.2 Governmental authorities

Table 4.21: Ranking and classification of barrier factors – for Governmental authorities

Ranking	Factor No	Category	Barriers to e-bidding	Importance index	Classification
1	18	Cultural	Organizational magnitude of changing management	83.33	High significant
2	9	Security	Security in the process - Data transmission to the wrong person – Confidentiality of information	81.67	
3	12	Security	Partial Data Display - incomplete documents provided	81.67	
4	14	Legal	Proof of intent - electronic signatures	81.67	
5	17	Cultural	Top or strategic management commitment for e-bidding	80.00	Medium high significant
6	11	Security	Data transmission reassembly - incorrect reassembly of data transmitted in packets	78.33	
7	13	Legal	Lack of pertinent case law	78.33	
8	7	Legal	No legal position of e-bidding- availability of regulations	76.67	
9	19	Cultural	Lack of national IT policy relating to e-bidding Issues	76.67	
10	21	Cultural	Complicated procedures.	75.00	
11	24	General	No business benefit realised	73.33	
12	1	Cultural	Staff resistance to change	71.67	
13	10	Security	Tampering with documents - changes to documents	71.67	
14	2	Cultural	Lack of technical expertise (Skilled staff)	70.00	Medium significant
15	8	Infrastructure	Insufficient assessment of systems prior to installation	70.00	
16	26	Infrastructure	Slow and bad internet service by service providers	70.00	

Ranking	Factor No	Category	Barriers to e-bidding	Importance index	Classification
17	5	Cultural	Bureaucratic dysfunctionalities	68.33	Medium significant
18	15	Legal	Clarity of tenderee and tenderer information	66.67	
19	20	Cultural	Lack of flexibility of organization's law and system	65.00	
20	23	Cost	E-bidding implementation cost (include system licences)	63.33	
21	4	General	No development of confidence to use new technologies	61.67	
22	16	Legal	Electronic bid evaluation	60.00	Medium low significant
23	3	Cultural	Staff turnover	55.00	
24	25	Compatibility	Investment in compatible systems	55.00	
25	6	Infrastructure	No company access to internet	53.33	
26	22	Cost	Cost of information technology investment	51.67	
27	27	Cost	Cost of internet service	40.00	Low significant

Based on Table 4.21, Governmental authorities rank shows that:

4 factors are "High significant"

9 factors are "Medium high significant"

8 factors are "Medium significant"

5 factors are "Medium low significant"

1 factor is "Low significant"

The high significant factors are:

1- Organizational magnitude of changing management.

2- Security in the process - Data transmission to the wrong person – Confidentiality of information.

3- Partial Data Display - incomplete documents provided.

4- Proof of intent - electronic signatures.

The medium high significant factors are:

1- Top or strategic management commitment for e-bidding.

2- Data transmission reassembly – incorrect reassembly of data transmitted in packets.

3- Lack of pertinent case law.

4- No legal position of e-bidding- availability of regulations.

5- Lack of national IT policy relating to e-bidding Issues.

6- Complicated procedures.

7- No business benefit realised.

8- Staff resistance to change.

9- Tampering with documents - changes to documents.

The medium significant factors are:

1- Lack of technical expertise (Skilled staff).

2- Insufficient assessment of systems prior to installation.

3- Slow and bad internet service by service

4- Bureaucratic dysfunctionalities.

5- Clarity of tenderee and tenderer information.

6- Lack of flexibility of organization’s law and system.

7- E-bidding implementation cost (include system licences).

8- No development of confidence to use new technologies.

The medium low significant factors are:

1- Electronic bid evaluation.

2- Staff turnover.

3- Investment in compatible systems.

4- No company access to internet.

5- Cost of information technology investment.

The low significant factor is:

1- Cost of internet service.

4.6 *Level of readiness*

The importance index in the following tables range from the lowest, around 40, to the highest, around 95. Given this range, in order to identify the most ready elements, the scale is made in between 40 and 95. The following figure graphically summarizes the 5 range categories.

Table 4.22: Ranking and importance index of readiness categorization

Importance	**Level of readiness**
40 – 50	Low
51 – 60	Medium low
61 – 70	Medium
71 – 80	Medium high
81 – 95	High

4.6.1 For organization readiness for e- bidding

4.6.1.1 Contractors

Table 4.23: Ranking and classification of readiness elements – for contractors

Ranking	Factor No	Readiness for E- bidding	Importance Index	level of readiness
1	5	Financial Sources to fund the system	78.00	Medium high
2	3	Organization higher management	75.00	
3	4	The available IT infrastructure in the organization	72.00	
4	1	Organization Staff (knowledge)	65.00	Medium
5	2	Organization Staff (resistance to change)	64.00	

Based on Table 4.23, contractor rank shows that:

3 elements are “Medium high”

2 elements are “Medium”

The medium high level of readiness elements are:

1- Financial Sources to fund the system.

2- Organization higher management.

3- The available IT infrastructure in the organization.

The medium level of readiness elements are:

1- Organization Staff (knowledge).

2- Organization Staff (resistance to change).

4.6.1.2 Governmental authorities

Table 4.24: Ranking and classification of readiness elements – for governmental authorities

Ranking	Factor No	Readiness for E- bidding	Importance Index	level of readiness
1	3	Organization higher management	85.00	High
2	5	Financial Sources to fund the system	78.33	Medium high
3	2	Organization Staff (resistance to change)	75.00	
4	4	The available IT infrastructure in the organization	65.00	Medium
5	1	Organization Staff (knowledge)	63.33	

Based on Table 4.24, governmental rank shows that:

1 element is “High”

2 elements are “Medium high”

2 elements are “Medium”

The high level of readiness element is:

1- Organization higher management.

The medium high level of readiness elements are:

1- Financial Sources to fund the system.

2- Organization Staff (resistance to change).

The medium level of readiness elements are:

1- The available IT infrastructure in the organization.

2- Organization Staff (knowledge).

4.6.2 For overall readiness for e- bidding

4.6.2.1 Contractors

Table 4.25: Ranking and classification of overall readiness elements – for contractors

Ranking	Factor No	Readiness for E- bidding	Importance Index	level of readiness
1	4	Internet Service Providers	72.00	Medium high
2	2	Construction Contractors	69.00	Medium
3	1	Governmental Authorities	62.00	
4	3	Governmental laws	47.00	Low

Based on Table 4.25, contractor rank shows that:

1 element is "Medium high"

2 elements are "Medium"

1 elements is "Low"

The medium high level of readiness element is:

1- Internet Service Providers.

The medium level of readiness elements are:

1- Construction Contractors.

2- Governmental Authorities.

The low level of readiness element is:

1- Governmental laws.

4.6.2.2 Governmental Authorities

Table 4.26: Ranking and classification of overall readiness elements – for governmental authorities

Ranking	Factor No	Readiness for E- bidding	Importance Index	level of readiness
1	2	Construction Contractors	80.00	Medium high
2	1	Governmental Authorities	76.67	
3	4	Internet Service Providers	76.67	
4	3	Governmental laws	60.00	Medium low

Based on Table 4.26, governmental authorities rank shows that:

3 elements are "Medium high"

1 elements is “Medium low”

The medium high level of readiness element is:

1- Construction Contractors.

2- Governmental Authorities.

3- Internet Service Providers.

The medium level of readiness elements are:

1- Governmental laws.

4.7 *Pearson correlation test*

In this section the agreement between the governmental authorities and the contractors is examined by using the Pearson correlation test for samples.

4.7.1 **Pearson correlation test on driver factors**

Figure 4.35 is a line graph showing the importance indices provided by the contractors and governmental authorities. This graph shows that there is a level of consistency amongst the parties. They almost agree in the frequencies of the driver factors. The Pearson correlation coefficient was used to confirm this conclusion. The Pearson correlation coefficient produced a value of 0.818, so the parties have an agreement of 81.8 %.

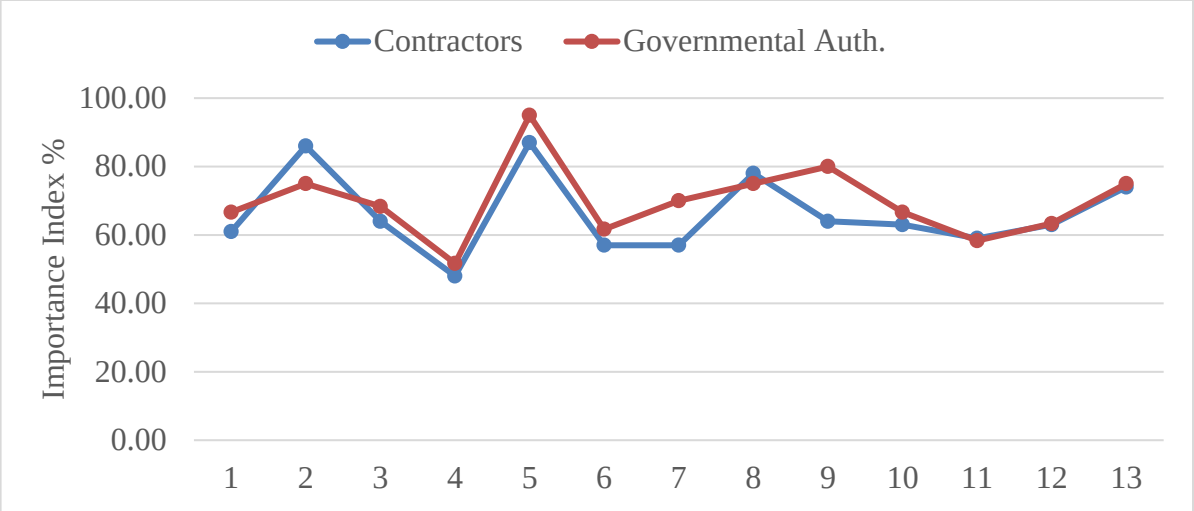

Figure 4.35: Line graph showing important index of both parties – Driver factors

4.7.2 **Pearson correlation test on barrier factors**

Figure 4.36 is a line graph showing the importance indices provided by the contractors and governmental authorities. This graph shows that there is a level of consistency amongst the parties. They almost agree in the frequencies of the driver factors. The Pearson correlation coefficient was used to confirm this conclusion. The Pearson correlation coefficient produced a value of 0.857, so the parties have an agreement of 85.7 %.

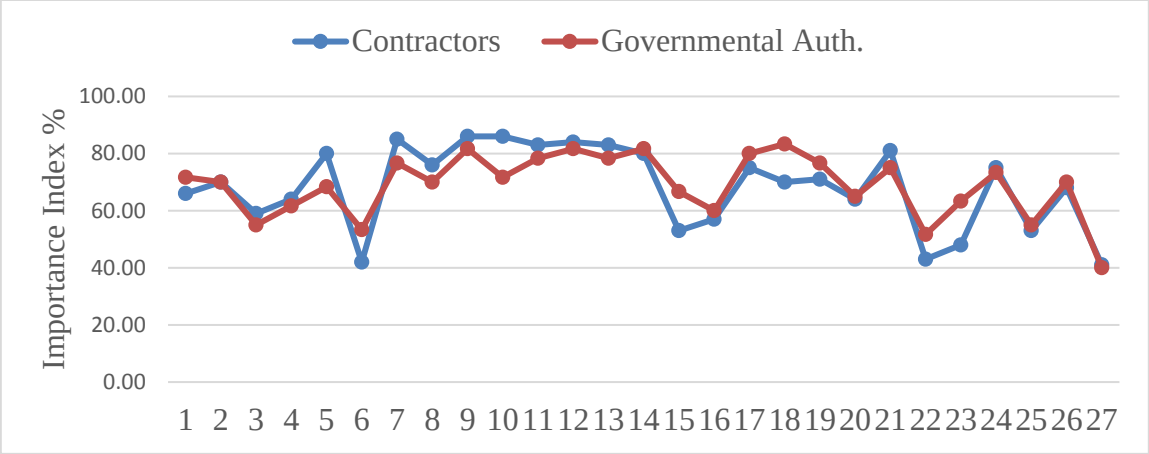

Figure 4.36: Line graph showing important index of both parties – Barrier factors

4.7.3 **Pearson correlation test on organization readiness for e-bidding**

Figure 4.37 is a line graph showing the importance indices provided by the contractors and governmental authorities. This graph shows that there is a less level of consistency amongst the parties. The Pearson correlation coefficient was used to confirm this conclusion. The Pearson correlation coefficient produced a value of 0.543, so the parties have an agreement of 54.3 %.

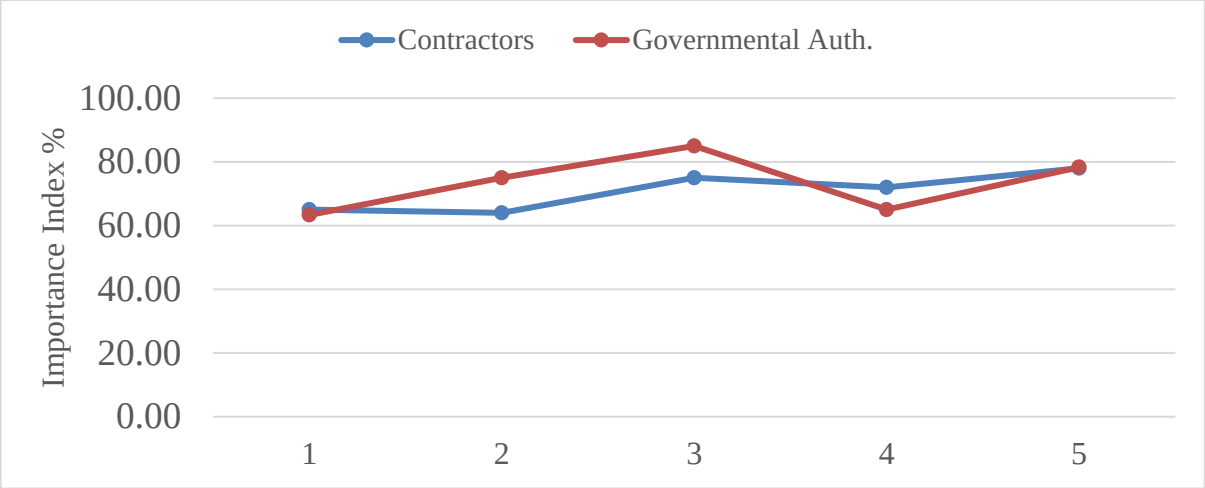

Figure 4.37: Line graph showing important index of both parties – organization readiness

4.7.4 **Pearson correlation test on overall readiness for e-bidding**

Figure 4.38 is a line graph showing the importance indices provided by the contractors and governmental authorities. This graph shows that there is a very high level of consistency amongst the parties. They almost agree in the frequencies of the overall readiness for e-bidding. The Pearson correlation coefficient was used to confirm this conclusion. The Pearson correlation coefficient produced a value of 0.927, so the parties have an agreement of 92.7 %.

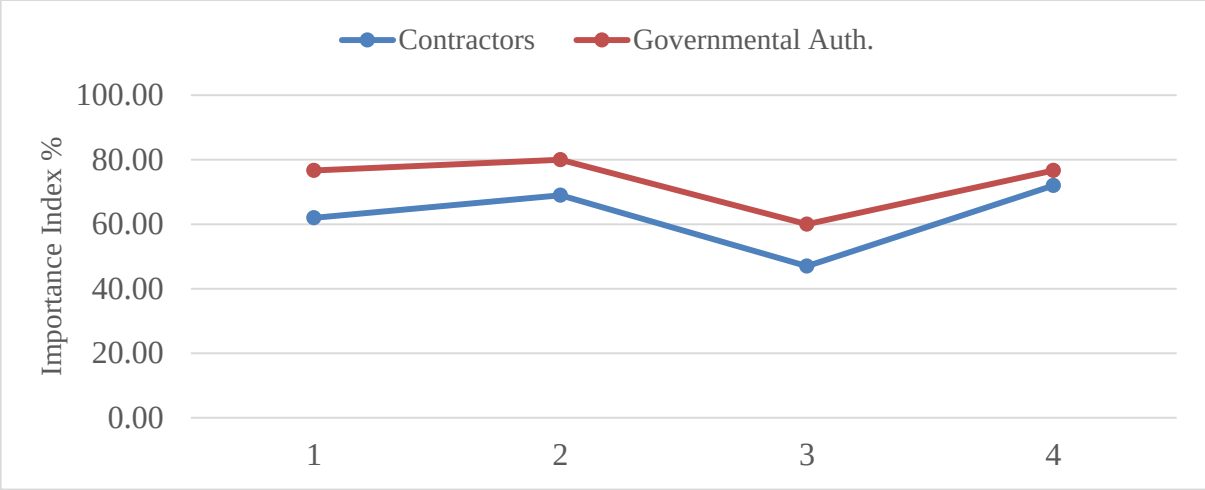

Figure 4.38: Line graph showing important index of both parties – overall readiness

4.8 *Spearman's Coefficient Rank correlation test*

In this section the agreement between the governmental authorities and the contractors is examined by using the Spearman's Coefficient Rank correlation test for samples.

4.8.1 Spearman's Coefficient Rank correlation on driver factors

The Spearman's Coefficient Rank correlation was used to identify how closely the results of contractors and governmental authorities were. The Spearman's Coefficient Rank correlation produced a value of 0.802. This shows that there is a level of consistency amongst the parties. In other words, they almost agree in the ranking of driver factors.

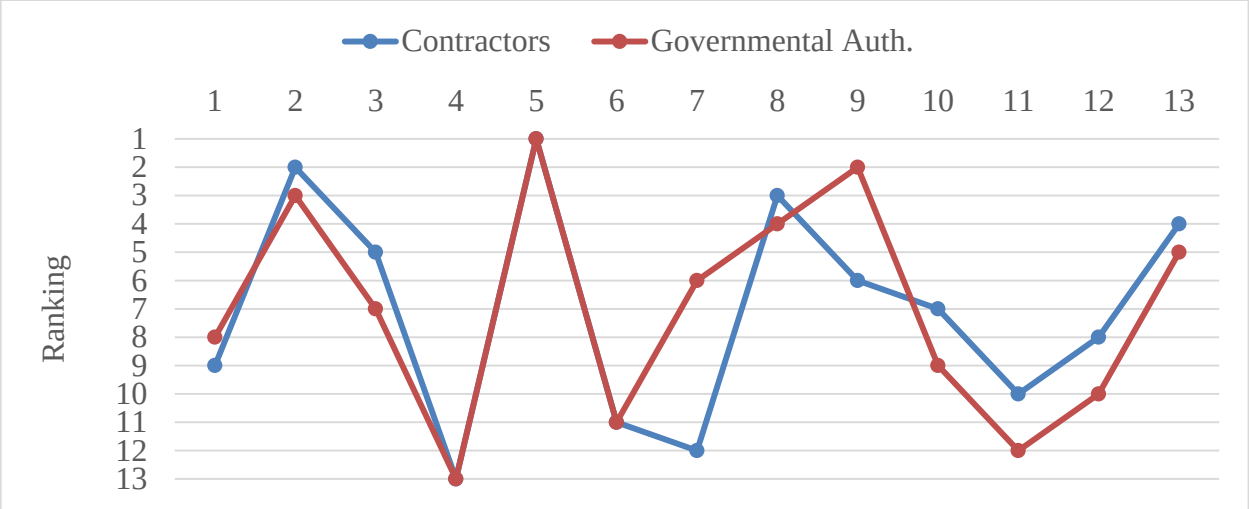

Figure 4.39: Line graph showing ranking of both parties – Driver factors

4.8.2 **Spearman's Coefficient Rank correlation on barrier factors**

The Spearman's Coefficient Rank correlation was used to identify how closely the results of the contractors and the governmental authorities were with respect to the rankings of the barrier factors. The Spearman's Coefficient Rank correlation produced a value of 0.81. This shows that there is a level of consistency amongst the parties. Stated differently, they almost agree in the ranking of barrier factors.

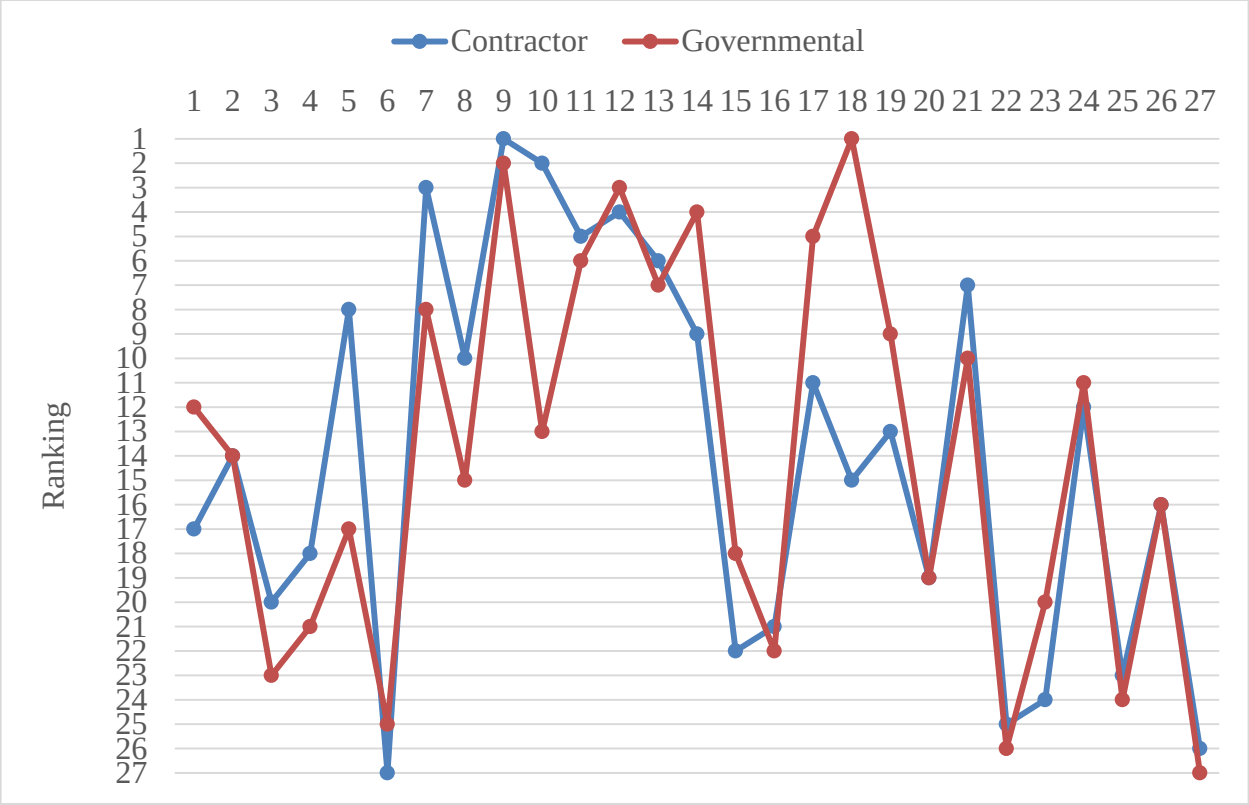

Figure 4.40: Line graph showing ranking of both parties – Barrier factors

4.8.3 **Spearman's Coefficient Rank correlation on organization readiness for e-bidding**

The Spearman's Coefficient Rank correlation was used to identify how closely the results of contractors and governmental authorities were with respect to the rankings of the organization's readiness for e-bidding. The Spearman's Coefficient Rank correlation produced a value of 0.6. This shows that there is a fine level of consistency amongst the

parties but still lower compared with the driver and barrier factors. They have level of fine agreement in the ranks of organization readiness for e-bidding.

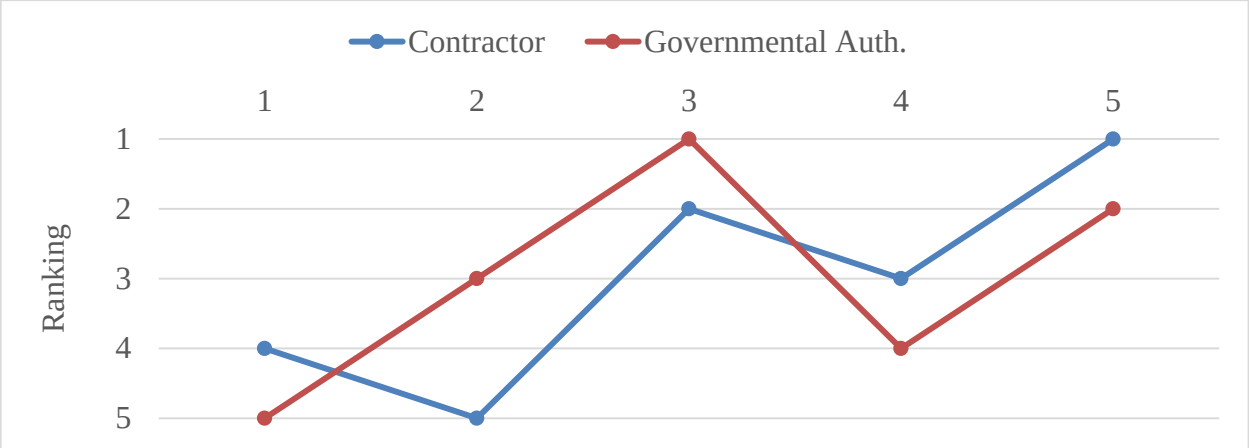

Figure 4.41: Line graph showing ranking of both parties – Organization readiness for e-bidding

4.8.4 **Spearman's Coefficient Rank correlation on overall readiness for e-bidding**

The Spearman's Coefficient Rank correlation was used to identify how closely the results of the contractors and the governmental authorities were with respect to the rankings of the overall readiness for e-bidding. The Spearman's Coefficient Rank correlation produced a value of 0.4. This shows that there is a moderate level of consistency amongst the parties but

still lower compared with driver, barrier factors and organization readiness for e-bidding. They have level of medium agreement in the ranks of overall readiness for e-bidding.

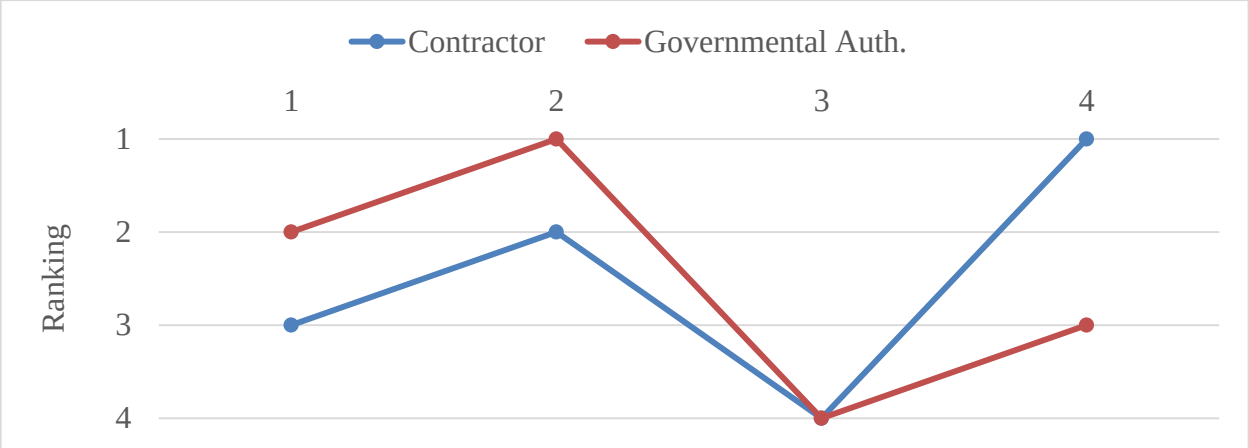

Figure 4.42: Line graph showing ranking of both parties – Overall readiness

4.9 *Hypothesis test*

4.9.1 **Hypothesis test on driver factors**

A T-test was conducted at a 95 % confidence. The P- value generated by the test was equal to 0.434. Since this value was higher than $\alpha = 0.05$, the null hypothesis could not be inadmissible. There was insufficient proof to reject the hypothesis.

4.9.2 **Hypothesis test on barrier factors**

A T-test was conducted at a 95 % confidence. The P- value generated by the test was equal to 0.857. Since this value was higher than $\alpha = 0.05$, the null hypothesis could not be inadmissible. There was insufficient proof to reject the hypothesis.

4.9.3 **Hypothesis test on organization readiness for e-bidding**

A T-test was conducted at a 95 % confidence. The P- value generated by the test was equal to 0.62. Since this value was higher than $\alpha = 0.05$, the null hypothesis could not be inadmissible. There was insufficient proof to reject the hypothesis.

4.9.4 **Hypothesis test on overall readiness for e-bidding**

A T-test was conducted at a 95 % confidence. The P- value generated by the test was equal to 0.181. Since this value was higher than $\alpha = 0.05$, the null hypothesis could not be inadmissible. There was insufficient proof to reject the hypothesis.

4.10 **Comments from respondents**

The suggestions given by the contractors and governmental authorities, both in writing and orally, are provided in this section.

4.10.1 **Contractors**

1- Two of the respondents agreed that security is a big concern. Hence, users need to be assured that their information will not be leaked, hacked and misused.

2-A respondent said that laws and regulations should be changed and modified in order to be able to accommodate e-bidding.

3- Another respondent mentioned that instead of having a separate e-bidding systems and different portals and formats for each governmental authority, it was better to revert to the former state prior to the cancellation of the ministry of public works in 2003 where there was only one authority to control the whole construction work.

4- Two of the respondents agreed that it was essential to have a legal framework for electronic transactions on the web. The acceptance of electronic contractual documents as an evidence in contractual dispute is very important.

5- A respondent said that there is a need to improve internet services and increase internet speeds and capacities.

6- Another respondent said there should be clear national IT policy.

7- Three respondents agreed that the roles and functions of electronic signature need to be clearly explained and activated.

8- Three respondents agreed that changing to e-bidding should be done smoothly and not rapidly within a given time frame. This time frame should comprise fixed milestones. Each milestone should be based on project types and costs.

9- Two respondents said that the mechanism of implementing e-bidding system itself should be clear to the contractors before implementation.

4.10.2 **Governmental Authorities**

1- A respondent mentioned that e-bidding system should be implemented gradually in stages and that each stage should be for certain types of projects with certain amount of money.

2- A respondent said that if the system implemented, in the first stages of the implementation contractor should submit paper based copy until a certain stage that governmental authorities can trust the system is working fine and contractors and the governmental authorities themselves are able to deal with this system.

3- Another respondent said that many of the heads of bidding sections in the governmental authorities are older employees. So that, most of them don't know how to deal with

advanced technology. Because of that, they may ask to hire assistances to help them even for checking small things operated through this system.

4- Two respondents wished not to copy and paste the system from another countries that their procurement system is totally different from the Saudi procurement system.

5- A respondent suggested that design offices which are involved in bidding stage due to clarifications and other reasons and governmental authorities' consultants should be linked to the system.

CHAPTER 5

Summary of the study, Conclusion and Recommendations

This chapter presents a summary of the study, findings, conclusion and recommendations.

5.1 *Summary of the study*

E-bidding system enables organizations to manage the whole bidding process electronically and on the web. Many benefits could be gained from using e-bidding system especially considering that one of the most important phases in the construction industry is the bidding process. Despite the benefits, there are many barriers against implementing this technology in Saudi Arabia governmental procurement system.

The main aim of this study was to identify the barriers, challenges and willingness to adopt the e-bidding system in Saudi Arabia by the stakeholders (i.e., governmental authorities and contractors).

The research methodology consists of the following steps beginning with the identification of drivers and barriers to e-bidding through the literature review, development of survey questionnaire and interviews, data collection, data analysis and finally presenting the findings at the end of the research and discussing and concluding the research.

This study consists of five chapters. Chapter 1 includes the introduction, statement of the problem, aim of the research, research significance and limitation.

Chapter 2 presented a discussion of the traditional tendering process and its problems and electronic bidding process and showed the barriers and drivers factors in the implementation of this system. The end part of this chapter covered the current situation in Saudi Arabia and reviewed the previous studies on the topic.

Chapter 3 shows the process that was adopted to realize the aim of this research. It contains the following steps beginning with the identification of drivers and barriers to e-bidding through the literature review, development of survey questionnaire and interviews, data collection, data analysis and finally presenting the findings at the end of the research and discussing and concluding the research.

Chapter 4 describes the results gained from the survey questionnaire. The results were presented in the form of tabular columns, graphs and percentages.

Chapter 5 on conclusions and recommendations deals with the findings made in relation to the obtained results. The latter part of the chapter revolves around recommendations for the future work in the concerned area of the thesis.

5.2 *Summary of findings*

The following is a summary of the study findings.

5.2.1 **Driver factors for e-bidding system**

1- The most important driver factors from the perspective of the contractors in Saudi Arabia are enhancing documents management and archiving and reducing transaction administration cost. The lowest important driver is increasing profit margin. The general category is the most important one and the cost category is the lowest important.
2- The most important driver factors to the governmental authorities in Saudi Arabia are enhancing documents management and archiving and reducing time by more transparency. The lowest important driver is increasing profit margin. The general category is the most important category while the cost category is the least important.

5.2.2 **Barrier factors for e-bidding system**

1- The most important barrier factors from the perspective of the contractors in Saudi Arabia are security in the process - data transmission to the wrong person – confidentiality of information and tampering with documents - changes to documents. The lowest ranked barrier factors are cost of internet services and no access to internet. The security category is the most important category while the cost category is the least important category.
2- The most important barrier factors from the perspective of governmental authorities in Saudi Arabia are organizational magnitude of changing management, Security in the process - Data transmission to the wrong person – Confidentiality of information, Partial Data Display - incomplete documents provided and Proof of intent - electronic

signatures. The least important barrier factors are the cost of internet services and no access to internet. The security category is the most important category and the cost category is the least important category.

5.2.3 **Organization readiness for e-bidding system**

1- The most ready element in the contracting organizations, from the contractor's perspective, are financial sources to fund the e-bidding system and the organization's higher management. The least ready element in the contractors' organizations is the organization's staff (resistance to change).
2- The most ready element in the governmental authorities, from the governmental authorities perspective, are the organization's higher management and financial sources to fund the system. The least ready element in the contractors' organizations is the organization's staff (from the knowledge perspective).

5.2.4 **Overall readiness for e-bidding system**

1- The most ready element in the construction industry, from the contractor's perspective, are internet service providers and construction contractors. The least ready element in the construction industry is governmental laws.

2- The most ready element in construction industry, from the governmental authorities perspective, are construction contractors and governmental authorities. The least ready element in the construction industry is governmental laws.

5.3 ***Conclusion***

From the results obtained in chapter 4, the conclusion of the study can be summarized as below:

1- The results of this research have shown that the level of awareness of e-bidding among the contractors' personnel is high in comparison to the governmental authorities' personnel since the contractors personnel are bidding for projects owned by companies that employ the the e-bidding system.

2- The key reason why the 'enhancing documents management and archiving' factor is considered by both the contractors and governmental authorities as being the most important driver factor is because all the transactions within an e-bidding system are electronic meaning that all the data will be saved in electronic format and in servers. This will facilitate in quick data sharing and protect data from getting lost or damaged.

3- Increasing the awareness of the benefits of e-bidding among the construction industry's personnel and establishing an e-bidding legal framework in the Saudi Arabian governmental procurement system are the keys to opening the door for e-bidding implementation in the Saudi Arabian construction industry.

4- The lack of awareness of the electronic transactions system and its accompanying regulations is one of the sources of the employee resistance to implement e-bidding in the governmental sector within the Saudi Arabian construction industry.

5- Security while working on an internet platform is a very big concern. The construction organizations' higher management should understand that any new technology has its advantages and disadvantages. At the same time, it will be difficult to introduce the system to the construction industry in Saudi Arabia without the e-bidding system implementers assuring the users that their information will not leaked out, hacked and it will not be misused.

6- E-bidding can't be fully implemented within a short period. The process of implementation will commence by the introduction of the system to the construction industry's stakeholders who will then start offering their employees training workshops and while all this is being undertaken, the organization will initiate the process of renewing or upgrading their IT infrastructure to accommodate the system. Besides all the aforementioned requirements, governmental authorities prepare new regulations that accept e-bidding.

7- Having one authority handle the electronic bidding activities will give the contractors a level of confidence and will reduce the amount of major mistakes that can be committed by governmental employees especially in the early stages of the e-bidding system implementation.

5.4 Recommendations

5.4.1 **For contractors**

1- The least ready elements in the contacting organisations are the organization's staff resistance to change and their knowledge on e-bidding. Despite 60% of the contractor's respondents being acquainted with e-bidding, they do not regularly apply this system as the implementation of e-bidding in Saudi Arabia is very limited. Contracting organisations are forced to send their employees to workshops and explain the benefits that can be gained from implementing an e-bidding system in order to shorten the time employees will take to accept e-bidding when it is launched.
2- Security is a big concern. For contractors, it appears as the highest barrier category. Contractors have to accept the system and deal with it with taking the maximum security precautions.

5.4.2 **For government**

1- Identifying of drivers should be focused for a new system need to be introduced in governmental authorities in order to gain the benefit. The highest ranked barriers need to be avoided or seek to mitigate their impact.
2- A Legal framework for e-bidding in the Saudi Arabian context is almost non-existent. Most of the respondents are unaware of any provisions in the Saudi Arabian governmental procurement law that legally permits electronic transactions. Government should start by establishing a legal framework as a first step in implementing e-bidding.

3- In order to start implementing e-bidding, the government needs to benchmark itself with an e-bidding implementing country that has procurement regulations roughly resembling that of the Kingdom.

4- The findings of this research have revealed that there is a level of awareness on e-bidding among the contractor personnel, while among governmental authorities' personnel the awareness is too low. The government has to send their employees to workshops, train them and explain the benefits that can be gained from implementing an e-bidding system in order to shorten the time employees will take to accept e-bidding when it is launched.

5- One of the least ready elements in the governmental authorities is the availability of IT infrastructure. The government should innovate and reconstruct the existing IT infrastructure to pave the way for e-bidding implementation to be ready to implement e-bidding system.

6- Security comes as the highest barrier category. The e-bidding system implementers need to assure both parties that all their information will be secured.

7- Despite there being a Royal Decree number 18/M dated 8th of Safar 1428 H related to electronic transactions and the Implementing Regulations issued by Communications and Information Technology Commission on Rabi I 1429 H, most of the governmental authorities insist on only accepting paper based transactions. Government should encourage the governmental authorities to establish rules to accept the electronic transaction in accordance with the rules stipulated in the Royal Decree and its implementation regulations.

5.4.3 **For future researches**

1- Future researches are needed to develop strategies to improve the drivers and reduce or mitigate barriers to e-bidding in Saudi Arabia.

2- There are some governmental authorities that have partially implemented e-bidding like the FARES system in the Ministry of Education and the Electronic Bidding system in Jeddah Municipality. It will be important to conduct a research to gain insight into the reasons why these systems are not fully implemented. This study will be critical in order to understand whether there are any similarities or differences in the factors that lead to the success of e-bidding that shown in the current research.

3- For future researches, design offices' and governmental authorities' consultants need to be involved in order to check their readiness to implement this system.

4- Researches need to be conducted to check if it is better to form a governmental entity, connected to the Ministry of Finance or Council of Ministers that exclusively focuses on electronic governmental bidding activities and all these activities will be done through its electronic portal.

5- A study is needed to establish a clear time frame for implementing e-bidding gradually in stages where each stage will be for certain types of projects with a certain project amount of money. Contractors' representative organisations, like The National Committee for Contractors, should participate beside the government in this study in order to produce a detailed time frame.

References

- Anumba, C. J., and Ruikar, K. (2002). Electronic commerce in construction—trends and prospects. *Automation in Construction*, *11*(3), 265-275.
- Arslan, G., Kivrak, S., Birgonul, M. T., and Dikmen, I. (2008). Improving sub-contractor selection process in construction projects: Web-based sub-contractor evaluation system (WEBSES). *Automation in Construction*, *17*(4), 480-488.
- Liao, T. S., Wang, M. T., and Tserng, H. P. (2002). A framework of electronic tendering for government procurement: a lesson learned in Taiwan. *Automation in construction*, *11*(6), 731-742.
- Blayse, A. M., and Manley, K. (2004). Key influences on construction innovation. *Construction innovation*, *4*(3), 143-154.
- Tindsley, G., and Stephenson, P. (2008). E-tendering process within construction: A UK perspective. *Tsinghua Science and Technology*, *13*, 273-278.
- Yang, J., Ahuja, V., and Shankar, R. (2007). Managing Building Projects through Enhanced Communication-An ICT Based Strategy for Small and Medium Enterprises. www.eprints.qut.edu.au/15565/1/15565.pdf
- Kajewski, S. L., Tilley, P. A., Crawford, J. R., Remmers, T. R., Chen, S. E., Lenard, D. and Haug, M. (2001). Electronic Tendering: An Industry Perspective. http://eprints.qut.edu.au/26873/1/26873.pdf
- Dikmen, I., and Birgonul, M. T. (2004). Neural network model to support international market entry decisions. *Journal of construction engineering and management*, *130*(1), 59-66.
- Chinyio, E. (2011, August). The cost of tendering. In *meeting of the Engineering Project Organizations, Colorado, USA*.

- Rimmer, S. J. (1991). Competitive tendering, contracting out and franchising: key concepts and issues. *Australian Journal of Public Administration*, *50*(3), 292-302.
- MONAFASAT system. (19th Oct. 2015) Retrieved from http://www. saudiegp.com.
- Vee, C., and Skitmore, C. (2003). Professional ethics in the construction industry. *Engineering, Construction and Architectural Management*, *10*(2), 117-127.
- Chan, L. S., Chiu, D. K., and Hung, P. C. (2007, July). E-tendering with web services: a case study on the tendering process of building construction. In *Services Computing, 2007. SCC 2007. IEEE International Conference on* (pp. 582-588). IEEE.
- Lou, E. C. W., and Alshawi, M. (2009). Critical success factors for e-tendering implementation in construction collaborative environments: people and process issues. *Journal of Information Technology in Construction (ITCon), 14*, 98-109.
- Oyediran, O. S., and Akintola, A. A. (2011). A survey of the state of the art of e-tendering in nigeria. *J. Inf. Technol. Constr., 16*, 557-576.
- Seah, E. (2008). Dos and don'ts for e-tendering-A quantity surveying perspective. *Project Control Professional*, *46*(5), 18.
- Martin, J. L. N. E-Bidding for Building Contracts in the UK. *AACE International Transactions, RICS*.
- Vaidya, K., Callender, G., Sajeev, A. S. M., and Gao, J. (2004, April). Towards a model for measuring the performance of e-procurement initiatives in the Australian public sector: a balanced scorecard approach. In *Australian e-Governance Conference, April* (pp. 14-15).
- Wong, C. H., and Sloan, B. (2004). Use of ICT for e-procurement in the UK construction industry: a survey of SMES readiness. In *Proceedings of ARCOM Twentieth Annual Conference 2004* (pp. 1-3).

- Betts, M., Black, P., Christensen, S. A., Dawson, E., Du, R., Duncan, W and Gonzalez Nieto, J. (2006). Towards secure and legal e-tendering. *Journal of Information Technology in Construction*, *11*, 89-102. http://eprints.qut.edu.au/6559

- Davila, A., Gupta, M., and Palmer, R. (2003). Moving Procurement Systems to the Internet: the Adoption and Use of E-Procurement Technology Models .*European Management Journal*, *21*(1), 11-23.

- Kheng, C. B., and Al-Hawamdeh, S. (2002). The adoption of electronic procurement in Singapore. *Electronic Commerce Research*, *2*(1-2), 61-73.

- Du, R., Foo, E., Boyd, C., and Fitzgerald, B. (2004, January). Defining security services for electronic tendering. In *Proceedings of the second workshop on Australasian information security, Data Mining and Web Intelligence, and Software Internationalization-Volume 32* (pp. 43-52). Australian Computer Society, Inc.

- Eadie, R., Perera, S., Heaney, G., and Carlisle, J. (2007). Drivers and barriers to public sector e-procurement within Northern Ireland's construction industry. *Journal of Information Technology in Construction*, *12*, 103-120.

- Eadie, R., Perera, S., and Heaney, G. (2010). Identification of e-procurement drivers and barriers for UK construction organizations and ranking of these from the perspective of quantity surveyors. *Journal of Information Technology in Construction*, *15*, 23-43.

- Rankin, J. H., Chen, Y., and Christian, A. J. (2006). E-procurement in the Atlantic Canadian AEC industry. *Electronic journal of information technology in construction*, *11*, 75-87.

- Egbu, C., Vines, M., and Tookey, J. (2004, September). The role of knowledge management in e-procurement initiatives for construction organizations. In *ARCOM Proceedings Twentieth Annual Conference* (pp. 661-671).

- Gunasekaran, A., and Ngai, E. W. (2008). Adoption of e-procurement in Hong Kong: an empirical research. *International Journal of Production Economics*, *113*(1), 159-175.

- Chilipunde, R. L. (2013). Electronic Tendering in the Malawian Construction Industry: The Dilemmas and Benefits.
- The Saudi competition and government procurement system issued by Royal Decree No. 58 dated in 4/9/1427H
- Implementing regulations of the governmental competition and procurement issued by the minister of finance Decree no. 362 dated 20/2/1428 H
- Public Works Contract model, Municipality of Taif city http://www.taifcity.gov.sa/photos/3208577.pdf
- Arslan, G., Tuncan, M., Birgonul, M. T., and Dikmen, I. (2006). E-bidding proposal preparation system for construction projects. *Building and Environment*, *41*(10), 1406-1413.
- Croom, S., and Johnston, R. (2003). E-service: enhancing internal customer service through e-procurement. *International Journal of Service Industry Management*, *14*(5), 539-555.
- Perdomo, J. L. The e-revolution: how could e-applications change the traditional construction management approach in Puerto Rico. *Fourth LACCEI International Latin American and Caribbean Conference for Engineering and Technology (LACCET'2006) "Breaking Frontiers and Barriers in Engineering: Education, Research and Practice" 21-23 June 2006, Mayagüez, Puerto Rico.*
- Knudsen, D. (2003). Aligning corporate strategy, procurement strategy and e-procurement tools. *International Journal of Physical Distribution and Logistics Management*, *33*(8), 720-734.
- Panayiotou, N. A., Gayialis, S. P., and Tatsiopoulos, I. P. (2004). An e-procurement system for governmental purchasing. *International Journal of Production Economics*, *90*(1), 79-102.
- Hawking, P., Stein, A., Wyld, D. C., and Foster, S. (2004). E-procurement: is the ugly duckling actually a swan down under? *Asia Pacific Journal of Marketing and Logistics*, *16*(1), 3-26.

- Love, P. E., Irani, Z., and Edwards, D. J. (2004). Industry-centric benchmarking of information technology benefits, costs and risks for small-to-medium sized enterprises in construction. *Automation in construction*, *13*(4), 507-524.
- Carayannis, E. G., and Popescu, D. (2005). Profiling a methodology for economic growth and convergence: learning from the EU e-procurement experience for central and eastern European countries. *Technovation*, *25*(1), 1-14.
- Peña-Mora, F., and Choudary, K. K. (2001). Web-centric framework for secure and legally binding electronic transactions in large-scale A/E/C projects. *Journal of Computing in Civil Engineering*, *15*(4), 248-258.
- Lavelle, D., and Bardon, A. (2009). E-tendering in construction: time for a change? *Northumbria Working Paper Series: Interdisciplinary Studies in the Built and Virtual Environment*, *2*(2), 104-112.
- Srivastava, A. (2009). Electronic signatures and security issues: An empirical study. *Computer Law and Security Review*, *25*(5), 432-446.
- Christenses, S., and Duncan, W. (2006). Maintaining the integrity of electronic tendering by government-Reflections on the capacity of the Australian legal framework to meet this challenge. *eLaw J.*, *13*, 8.
- Yap, C. S., Thong, J. Y., and Raman, K. S. (1994). Effect of government incentives on computerization in small business. *European Journal of Information Systems*, *3*(3), 191-206.
- Ebrahim, Z., and Irani, Z. (2005). E-government adoption: architecture and barriers. *Business process management journal*, *11*(5), 589-611.
- Mose, J. M., Njihia, J. M., and Peterson, O. M. (2013). The critical success factors and challenges in e-procurement adoption among large scale manufacturing firms in Nairobi, Kenya. *European Scientific Journal*, *9*(13).
- Aleid, F., Rogerson, S., and Fairweather, B. (2009). Factors Affecting Consumers Adoption of Ecommerce in Saudi Arabia from a Consumers' Perspective. In *IADIS International Conference e-Commerce* (pp. 11-18).
- Cerf, V. G., and Icahn, R. E. (2005). A protocol for packet network intercommunication. *ACM SIGCOMM Computer Communication Review*, *35*(2), 71-82.

- Abdul-Hadi, N. H. (1990). Factors affecting bidding and markup decisions in Saudi Arabia (King Fahd University of Petroleum and Minerals pp. 46)

Appendices

Appendix 1

Survey letter and questionnaire

INVITATION LETTER

Dear Respondent,

I'm student at Master of Science program of the Construction Engineering and Management Department of the college of Environmental Design at King Fahd University of Petroleum and Minerals, I'm working on my Master thesis under the supervision of professor Sa'adi Assaf. The aim of this research is to understand barriers, drivers and readiness to implement electronic bidding (e-bidding) in the construction industry. This survey, which is part of this study, will identify the factors that affect the implementation of e-bidding in governmental sector within Saudi Arabia's construction industry.

This Survey will take you approximately 10-15 minutes to complete. Your responses will be kept confidential and used only for the purpose of conduction this research.

Your time in completing this survey is highly appreciated. If you have any questions, suggestions or comments, please do not hesitate to contact me.

Dr. Sa'adi Assaf
Professor
Construction Engineering & Management Department
College of Environmental Design
King Fahd University of Petroleum and Minerals
Email: assaf@kfupm.edu.sa

Eng. Ahmed M. Zaki
Master of Science Student
Construction Engineering and Management Dep.
College of Environmental Design
King Fahd University of Petroleum and Minerals
Email: g201201600@kfupm.edu.sa

Part (1) : Organization Profile :

This part contains questions seeking information about your organization. Kindly answer the following questions either by writing your answers in the given spaces, or, by placing a tick (√) in the appropriate box:

1. Organization name : _____

2. What is the age of your organization in years?

☐ Less than 5 ☐ 5 to less than 10 ☐ 10 to less than 15

☐ 15 to less than 20 ☐ 20 to less than 25 ☐ Equal to or more than 25

3. What is the number of your organization employees?

☐ Less than 50 ☐ 50 to less than 200 ☐ 200 to less than 500

☐ 500 to less than 700 ☐ 700 to less than 1000 ☐ Equal to or more than 1000

4. What is the number of your bidding department employees? Is it enough? ☐ Yes ☐ No

☐ Less than 5 ☐ 5 to less than 10 ☐ 10 to less than 15

☐ 15 to less than 20 ☐ 20 to less than 25 ☐ Equal to or more than 25

5. What is the average million SR construction contracts your organization is constructing (if you are a contractor) or owned by you (if you are an owner) and under construction currently?

☐ Less than 50 ☐ 50 to less than 200 ☐ 200 to less than 500

☐ 500 to less than 700 ☐ 700 to less than 1000 ☐ Equal to or more than 1000

6. What is the average (approximately) million SR construction contracts under bidding in your organization currently?

☐ Less than 50 ☐ 50 to less than 200 ☐ 200 to less than 500

☐ 500 to less than 700 ☐ 700 to less than 1000 ☐ Equal to or more than 1000

7. What is your organization capital in million SR? ☐ Not applicable for gov. authorities

☐ Less than 1 ☐ 1 to less than 10 ☐ 10 to less than 50

☐ 50 to less than 100 ☐ 100 to less than 500 ☐ Equal to or more than 500

8. What are the types of projects executed by your organization (Please select all that apply)?

☐ Building ☐ Industrial ☐ Infrastructure

☐ Utilities ☐ Special Structure

☐ Others, please specify: _____

9. Where is the location of your organization head office?

☐ Dammam ☐ Khobar ☐ Jubail

☐ Dhahran ☐ Riyadh

☐ Others, please specify: _____

10. Is the organization has IT system?

☐ Yes ☐ No

If "Yes "please inform how many years the organization has IT system: _____

11. What is the rank, according to contractors classification agency - Ministry of Rural Affairs, for the main field of your organization? ☐ Not applicable for gov. authorities

	1st	2nd	3rd	4th	5th
☐ Buildings construction	☐	☐	☐	☐	☐
☐ Roads construction	☐	☐	☐	☐	☐
☐ Water and Sewer Pipe line construction	☐	☐	☐	☐	☐

Part (2) : Respondent's Profile :

This part contains questions seeking information about the respondent of this questionnaire. Kindly answer the following questions either by writing your answers in the given spaces, or, by placing a tick (√) in the appropriate box:

1. Respondent's Name : _____ job:_____
2. Respondent's E-mail : _____
3. Respondent's job title in the organization : _____
4. What is your educational level?

☐ Diploma ☐ Bachelor Degree ☐ Master Degree

☐ Doctorate of Philosophy ☐ Others, please specify: _____

5. Do you have experience in bidding field?

☐ Yes ☐ No

6. Do you have any previous experience in e- bidding field?

☐ Yes ☐ No

7. How many years you have been in your current position?

☐ Less than 5 ☐ 5 to less than 10 ☐ 10 to less than 15

☐ 15 to less than 20 ☐ 20 to less than 25 ☐ Equal to or more than 25

8. How many years you have been in your current organization?

☐ Less than 5 ☐ 5 to less than 10 ☐ 10 to less than 15

☐ 15 to less than 20 ☐ 20 to less than 500 ☐ Equal to or more than 25

9. How many years you have experience in construction industry field?

☐ Less than 5 ☐ 5 to less than 10 ☐ 10 to less than 15

☐ 15 to less than 20 ☐ 20 to less than 25 ☐ Equal to or more than 25

10. How many years you have experience in bidding field?

☐ Less than 5 ☐ 5 to less than 10 ☐ 10 to less than 15

☐ 15 to less than 20 ☐ 20 to less than 25 ☐ Equal to or more than 25

11. How many years you have experience in Saudi Arabia construction industry?

☐ Less than 5	☐ 5 to less than 10	☐ 10 to less than 15
☐ 15 to less than 20	☐ 20 to less than 25	☐ Equal to or more than 25

Part (3) : Survey for driving factors affect E-bidding adoption :

The following are potential driving factors that may affect E-bidding adoption. You are kindly requested to indicate the level of effect of these factors on the organizations to adopt and use e- tendering by placing a tick (√) in the appropriate box for a scale of 5 to 1 where 5 represents a very high effect and 1 represent no effect:

No	Drivers to e-bidding	Level of effect				
		5	4	3	2	1
1	Reducing Process Cost -(Bidding Process)					
2	Reducing Transaction Administration Cost					
3	Reducing Administration Costs in general					
4	Increasing Profit Margins (For Contractors)					
5	Enhancing documents Management and Archiving					
6	Decreasing in expenses by reducing staffing levels					
7	Shortening Overall bidding process time consuming					
8	Shortening Communication process time consuming					
9	Reducing time by clearer transparency					
10	Reducing evaluation (bid assessment) time					
11	Enhancing Quality by increasing competition					
12	Enhancing Quality by increasing efficiency					
13	Enhancing Quality by Improving Communication					

Part (4) : Survey for barriers affect E-bidding adoption :

The following are potential barriers that may affect E-bidding adoption. You are kindly requested to indicate the level of effect of these factors on the organizations to adopt and use e- tendering by placing a tick (√) in the appropriate box for a scale of 5 to 1 where 5 represents a very high effect and 1 represent no effect:

No	Barriers to e-bidding	Level of effect				
		5	4	3	2	1
1	Staff resistance to change					
2	Lack of technical expertise (Skilled staff)					
3	Staff turnover					
4	No development of confidence to use new technologies					
5	Bureaucratic dysfunctionalities					
6	No company access to internet					
7	No legal position of e-bidding- availability of regulations					
8	Insufficient assessment of systems prior to installation					
9	Security in the process - Data transmission to the wrong person – Confidentiality of information					
10	Tampering with documents - changes to documents					
11	Data transmission reassembly - incorrect reassembly of data transmitted in packets					
12	Partial Data Display - incomplete documents provided					
13	Lack of pertinent case law					
14	Proof of intent - electronic signatures					
15	Clarity of tenderee and tenderer information					
16	Electronic bid evaluation					
17	Top or strategic management commitment for e-bidding					
18	Organisational magnitude of changing management					

No	Barriers to e-bidding	Level of effect				
		5	4	3	2	1
19	Lack of national IT policy relating to e-bidding Issues					
20	Lack of flexibility of organisation's law and system					
21	Complicated procedures.					
22	Cost of information technology investment					
23	E-bidding implementation cost (include system licences)					
24	No business benefit realised					
25	Investment in compatible systems					
26	Slow and bad internet service by service providers					
27	Cost of internet service					

Part (5) : Survey for organization readiness for E- bidding:

The following to rank your organization readiness for e-bidding. You are kindly requested to indicate the level of readiness of the organizations to adopt and use e- tendering by placing a tick (√) in the appropriate box for a scale of 5 to 1 where 5 represents very ready and 1 represent not ready:

No		Level of readiness				
		5	4	3	2	1
1	Organisation Staff (knowledge)					
2	Organisation Staff (resistance to change)					
3	Organisation higher management					
4	The available IT infrastructure in the organisation					
5	Financial Sources to fund the system					

Part (6) : Survey for overall readiness for E- bidding:

The following to rank overall readiness for e-bidding. You are kindly requested to indicate the level of readiness of the organizations to adopt and use e- tendering by placing a tick (√) in the appropriate box for a scale of 5 to 1 where 5 represents very ready and 1 represent not ready:

No		Level of readiness				
		5	4	3	2	1
1	Governmental Authorities					
2	Construction Contractors					
3	Governmental laws					
4	Internet Service Providers					

Part (7) : Proposal for any other barriers or driving factors affect E-bidding adoption or any other comment :

This part provide you an opportunity to propose any other barriers or driving factors affect E-tendering adoption or any other comment that you believe that they are important to be mentioned :

Appendix 2

List of grade 1 and 2 contractors in eastern province of Saudi Arabia

المملكة العربية السعودية
وزارة الشؤن البلدية والقروية
وكالة تصنيف المقاولين
الرياض - فاكس 4035433

قائمة بالمقاولين المصنفين

رقم المقاول	اسم المقاول	اسم المجال	اسم المنطقة	درجة التصنيف	اسم المدينة	تاريخ التصنيف
698	شركة مجموعة محمدالمعجل	المباني	المنطقة الشرقية	الاولى	الدمام	1433/04/28
2039	شركة سعد للتجارة والمقاولات والخدمات المالية	المباني	المنطقة الشرقية	الاولى	الخبر	1435/09/19
15473	شركة اعمار المشاريع للمقاولات العامة	المباني	المنطقة الشرقية	الاولى	الخبر	1435/01/07
4255	شركة أزميل للمقاولات	المباني	المنطقة الشرقية	الاولى	الجبيل	1435/02/21
1562	شركة ناصر سعيد الهاجرى وشريكه للمقاولات	المباني	المنطقة الشرقية	الاولى	الثقبه	1436/08/10
10439	شركة بايتور السعودية العربية للانشات	المباني	المنطقة الشرقية	الاولى	الخبر	1434/07/09
1348	شركة ابتك للمقاولات المحدودة	المباني	المنطقة الشرقية	الاولى	الدمام	1435/03/15
16630	شركة كوندريكو السعوديه المحدودة	المباني	المنطقة الشرقية	الاولى	الجبيل	1433/11/15
4686	شركة التطوير والاستثمار العقاري المحدودة	المباني	المنطقة الشرقية	الاولى	الدمام	1435/07/05
1824	شركة الخنيني العالمية المحدودة	المباني	المنطقة الشرقية	الاولى	الجبيل	1435/11/26
10331	شركة شيد المحدودة	المباني	المنطقة الشرقية	الاولى	الدمام	1436/08/08
377	شركة أبناء عبدالله عبدالمحسن الخضري	المباني	المنطقة الشرقية	الاولى	الدمام	1435/03/08
1266	شركة المهيدب للمقاولات	المباني	المنطقة الشرقية	الاولى	الدمام	1432/12/02
604	شركة نسما و شركاهم للمقاولات المحدودة	المباني	المنطقة الشرقية	الاولى	الخبر	1436/12/24
4996	المؤسسة الشرقيه للتجارة والتعهدات	المباني	المنطقة الشرقية	الاولى	الخبر	1433/04/18
5607	شركة كتانه للانشاء العربيه السعودية المحدودة	المباني	المنطقة الشرقية	الاولى	الخبر	1433/04/18
4599	شركة الكفاح القابضة	المباني	المنطقة الشرقية	الاولى	الاحساء	1433/09/10
510	مؤسسة عبدالرحمن علي التركى للتجاره والمقاولات	المباني	المنطقة الشرقية	الاولى	الدمام	1433/10/09
10314	شركة رموز الاتحاد الخليجي للمقاولات	المباني	المنطقة الشرقية	الاولى	الخبر	1434/04/02
15351	شركة العسيس للمقاولات	المباني	المنطقة الشرقية	الاولى	الدمام	1434/10/18
295	شركة رضايات المحدودة	المباني	المنطقة الشرقية	الاولى	الخبر	1436/06/10
834	شركة اليمامة للأعمال التجارية والمقاولات	المباني	المنطقة الشرقية	الاولى	الدمام	1436/09/11

المملكة العربية السعودية
وزارة الشؤن البلدية والقروية
وكالة تصنيف المقاولين
الرياض - فاكس 4035433

قائمة بالمقاولين المصنفين

رقم المقاول	اسم المقاول	اسم المجال	اسم المنطقة	درجة التصنيف	اسم المدينة	تاريخ التصنيف
4815	شركة اتحاد المملكة للمقاولات	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1433/04/28
10442	شركة جاس الدولية للمقاولات	المباني	المنطقة الشرقية	الثانيـة	الدمام	1434/07/15
1946	شركة المشارق للتجارة والمقاولات لاصحابها سعد محمد الزهراني وشريكه	المباني	المنطقة الشرقية	الثانيـة	الدمام	1435/03/04
2214	شركة سراكو	المباني	المنطقة الشرقية	الثانيـة	الدمام	1435/03/04
1507	شركة الحقيل للمقاولات المحدودة	المباني	المنطقة الشرقية	الثانيـة	الدمام	1436/06/10
16699	شركة بيت المودة للمقاولات العامة	المباني	المنطقة الشرقية	الثانيـة	الدمام	1434/09/22
4520	شركة النبأالعالمية للمشاريع التجارية لأصحابها /مطلق محمد بن نبأ القحطاني وأخوانه	المباني	المنطقة الشرقية	الثانيـة	الجبيل الصناعيه	1432/09/16
10409	شركة أمانة السعودية للمقاولات المحدودة	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1434/05/01
4747	مجموعة عبدالله بن محمد ابابطين	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1433/04/21
1326	شركة عطيه مساعد الثبيتي وأخوانه	المباني	المنطقة الشرقية	الثانيـة	الدمام	1432/11/03
1909	شركة الجفر للتجارة والمقاولات لاصحابها وليد فهد الذرمان و شركاه	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1437/01/09
3948	شركة المنار العربية للتجارة والمقاولات المحدودة	المباني	المنطقة الشرقية	الثانيـة	الدمام	1433/04/07
4691	شركة التعمير والانشاء المحدوده	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1434/01/18
3246	مؤسسة إبراهيم السماعيل للمقاولات العامة	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1435/02/27
4752	مؤسسة عثمان صالح الغامدي للمقاولات	المباني	المنطقة الشرقية	الثانيـة	الدمام	1435/02/01
239	شركة الخليج العربى للانشاءات المحدودة	المباني	المنطقة الشرقية	الثانيـة	الدمام	1433/03/01
1449	مؤسسة التركى للتجارة	المباني	المنطقة الشرقية	الثانيـة	الدمام	1433/04/04
447	شركة علي حسين اليامي وشريكه للتجارة و المقاولات	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1435/02/26
4756	مؤسسة عبدالله المسحل للمقاولات	المباني	المنطقة الشرقية	الثانيـة	الجبيل	1436/06/26
16973	شركة حيدر صالح ال حيدر و شريكه للمقاولات العامة والصيانة والتشغيل	المباني	المنطقة الشرقية	الثانيـة	الجبيل	1436/07/18
10100	الشركة العربية الحديثة للانشاءات المحدودة	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1433/06/10
16313	شركة أحمد ناصر البنعلى وأولاده للتجارة والمقاولات	المباني	المنطقة الشرقية	الثانيـة	الدمام	1434/01/26
15588	مؤسسة الاعمال الوطنية للمقاولات	المباني	المنطقة الشرقية	الثانيـة	حفر الباطن	1434/11/20
964	شركة ماضي بن محمد الهاجري وشركاه	المباني	المنطقة الشرقية	الثانيـة	الثقبه	1434/09/02
17571	شركة محمد عبدالله العثمان للتجارة والمقاولات	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1436/04/29
4952	مؤسسة عابد علي الحبشي للمقاولات	المباني	المنطقة الشرقية	الثانيـة	الدمام	1436/06/04
4472	شركة خضير للتجارة والمقاولات	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1434/05/18
10260	شركة يوكسال إنشاءات السعوديه	المباني	المنطقة الشرقية	الثانيـة	الدمام	1433/06/25
15627	شركة مسماك للإنشاء والتطوير	المباني	المنطقة الشرقية	الثانيـة	الخبـر	1435/11/23

VITAE

Personal Information

Name:	Ahmed Mohammed Zaki Sayed
Date of Birth :	19th October 1986
Place of Birth:	Dammam, Kingdom of Saudi Arabia
Nationality :	Egyptian
Current Address:	Al Yamama Company, P.O. 2110 ,Dammam 31451, Saudi Arabia
Permanent Address :	9, Dr. Taha Hussien street, El Nozha, Cairo, Egypt
Phone No. :	+966542471475 / +20226324872
Email Address :	zaki_ayc@hotmail.com

Educational Qualification

Institution name	Degree	Passing Year	Graduation Grade / GPA
Helwan University , Cairo, Egypt	BSc. Civil Engineering	May 2008	V. Good with Honor Rank
King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia	MSc. Construction Engineering & Management	May 2016	3.75

Experience

Position name	Organization	Period
Cost Estimator / Planning Engineer	Egyptian Project Management Consultancy – Giza, Egypt	July 2008 to January 2009
Cost Estimator in Tendering Department / Assistant of Project Manager	Al Yamama Company for Trading and Contracting – Dammam, Saudi Arabia	January 2009 to May 2016